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AUTHOR Sakamoto, A. Dorothy
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ABSTRACT

The Seattle School District (Washington) assigns each of its students to a particular attendance area, gives that area a code name and computer designation called a geocode, then uses data processing methods to analyze the makeup of the student population in each area and to provide data for a number of planning purposes. The geoprocessing permits not only analysis of data in tabular form, but also graphic presentation of attendance patterns through computer-produced school district maps. The district updates its information weekly to provide current data applicable to desegregation planning, facility utilization and school closure planning, student school assignment, student transportation planning, geographic distribution of special programs, and enrollment forecasting. This report discusses each of these applications of the geoprocessing system and provides samples of the computer output associated with each use. (PGD)

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A. Dorothy Sakamoto
Student Information Systems Office
Seattle Public Schools
Seattle, WA 98109

GEOPROCESSING AT THE SEATTLE SCHOOL DISTRICT *

ABSTRACT. During the decade of the 70's, large urban public school districts throughout the nation were faced with problems of racially impacted schools, declining student enrollment, aging school facilities and limited resources. The Seattle School District turned to geoprocessing technology in its quest for solutions to these critical concerns. Investing in a technically advanced geocoding system, the District was able to analyze residential distribution of its student population. This information enabled the District to close schools, design and operate a residence-based desegregation plan, defend the plan in the Supreme Court, operate an expanded student transportation program, and develop a geographically oriented enrollment projection system. These geoprocessing activities developed over the last 13 years. Geocoding is now embedded in Seattle School District's daily management and administrative functions.

INTRODUCTION

Geocoding is the automated process of translating street addresses to its related geographic codes, or geocodes, and appending these geocodes to data files containing addresses. The student file at the District is geocoded and updated weekly. This gives any data on the student file a geographic base. For example, the school attendance area in which a student resides is a geocode. Summary data such as number of students by ethnicity, grade level, handicap, special program needs or any other element on the data file can be tabulated by attendance area. Other geocodes and their uses are explained under Geocoded Student Master File.

The process of geocoding, analyzing, and displaying geocoded data is known as geoprocessing. Geoprocessing is now an irreplaceable cornerstone in the Seattle School District's day-to-day operations and programs as the following list indicates:

*Recipient of the 1984 Exemplary System in Government Award from the Urban and Regional Information Systems Association (URISA).

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- The Seattle residence-based desegregation plan, completing its 6th year, was built on the capabilities of the District's geocoding system.

- The Student Placement Activity Master file (SPAM) system, was developed to monitor and administer the desegregation plan through maintenance of student placement activities and geographic-based school assignments.

- Seattle successfully defended its desegregation plan in the Supreme Court against the lawsuit challenging Initiative 350, the anti-busing bill. An analysis of geocoded student residential data demonstrated that schools cannot be racially integrated if students were to be assigned to the schools closest to their residences.

- Twenty-five schools have been closed since 1979. Geoprocessing allowed simulated models of these closures to be thoroughly analyzed and discussed prior to closing schools in the midst of just having implemented the desegregation plan.

- The Student Placement Office relies totally on its interactive street directory system for queries on school assignment based on residential addresses. School secretaries completely depend on the printed directories from that system to assign new students or transfer students moving to another area in the city.

- A new enrollment forecasting system was developed to analyze current and historic geocoded student data by using geographic building blocks.

- The evolving automated student transportation system depends on geocoding to assign various area codes to students prior to assigning them to bus routes and stops.

- Placement of special programs such as special education, bilingual and alternative programs is determined by analyzing residential distributions of its attending population.

BACKGROUND

At the heart of all these geoprocessing activities is the GEOBASYS geocoding system. GEOBASYS, acronym for GEOgraphic BAse SYStem, was conceived by Dr. Edgar M. Horwood and developed under his tutelage in the early 1960's at the University of Washington and in its Urban Data Center. The geocoding system which predates the census DIME file, was technically advanced for its day. The system utilizes a street segment file and a series of sophisti-

cated software to produce 3 levels of geocodes. In 1970, the Seattle School District, concerned about its growing minority student population and the nationwide issue of school desegregation, was ripe for geocoding technology. The Urban Data Center needed some real world applications of the technology. The two agencies met and a unique partnership was born. The system was internalized on the District computer and software was maintained flexible enough to serve local community users as well as the District.

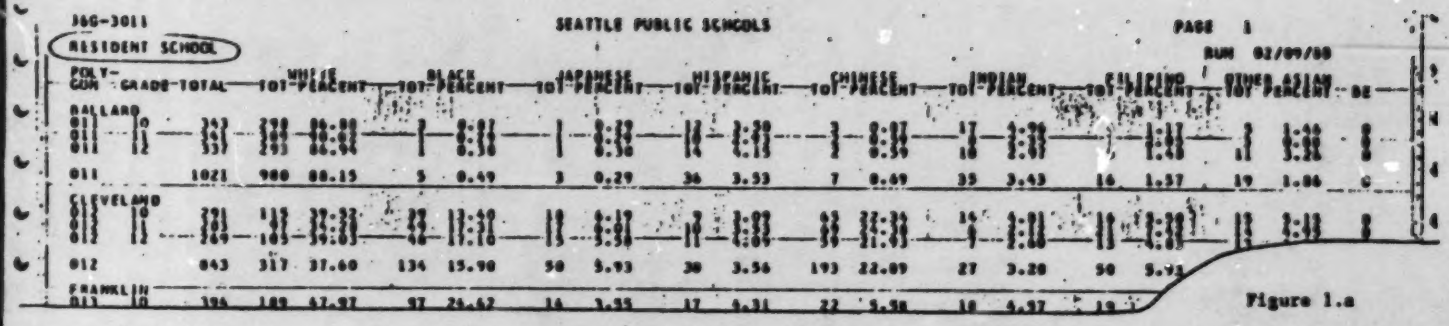
For five years, the partnership flourished. The quality of the geographic base file improved and additional systems and applications were developed for the District and other community users. Funds generated by outside activities helped finance the high costs of maintaining a quality system which in turn served to educate the community in the technology. The leadership and success of this venture must be attributed in large part to Dr. Charles E. Barb, Jr. of the Urban Data Center. Applications of the technology from this experience is documented in his research paper, Automated Street Address Geocoding Systems, Their Local Adaptation and Institutionalization.

In 1975, the local school levy failed. The following year the impact of that failure was felt in deep budget cuts throughout the District. The partnership between the Urban Data Center and Seattle School District was terminated. Although the geocoding system remained virtually maintenance free for almost 8 years, new applications were possible because of the solid base on which the system was built. Age, however, is beginning to take its toll and discussions are underway to upgrade the Geographic Base File (GBF) by reformatting it for a data base system.

GEOPROCESSING ACTIVITIES

Geocoded Student Master File (GSMF)

A geocoded file of currently active students, maintained and updated weekly, is the basic data source for district geoprocessing activities. The GSMF contains 15 basic administrative codes along with 3 types of geocodes: area codes, coordinates, and network node codes. The area codes are census tract and block, and school attendance areas. Thus, student data can be aggregated and analyzed by these areas as shown in sample reports, figures 1 to 3. Coordinates are defined for actual location of the address, and for the block face centroid of the street side on which the dwelling exists. Block face coordinates are generally used. Coordinates allow data to be plotted as explained in the section on Graphics, and for distances to be calculated between points. But the greatest advantage with coordinates is the ability to geocode additional area codes to files already containing geocoded coordinates. The procedure is to develop polygons with vertex points as coordinates of the GBF. The data file is then processed through the polygons with the point-in-polygon pro-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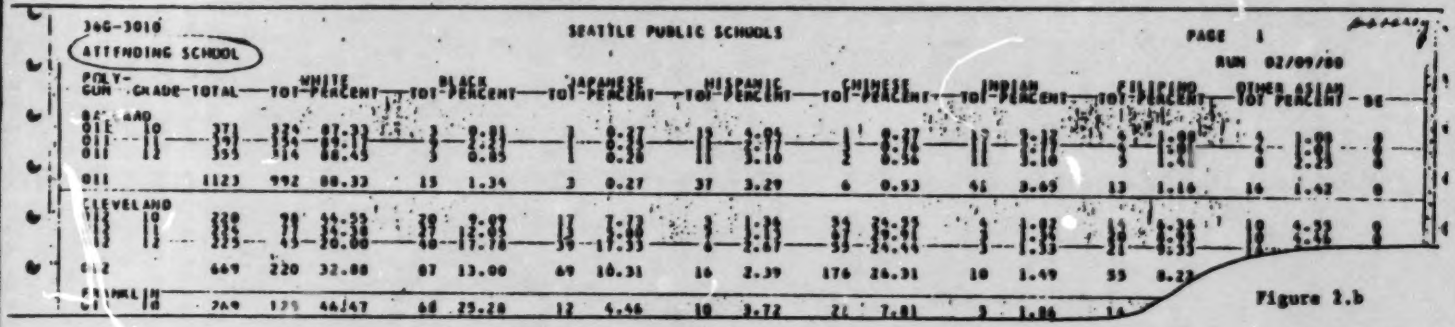
CLEVELAND
012 843 317 37.60 134 15.90 50 5.93 30 3.56 193 22.89 27 3.20 50 5.93
FRANKLIN
013 394 189 47.97 97 24.62 14 3.55 17 4.31 22 5.58 18 4.57 19

Figure 1.a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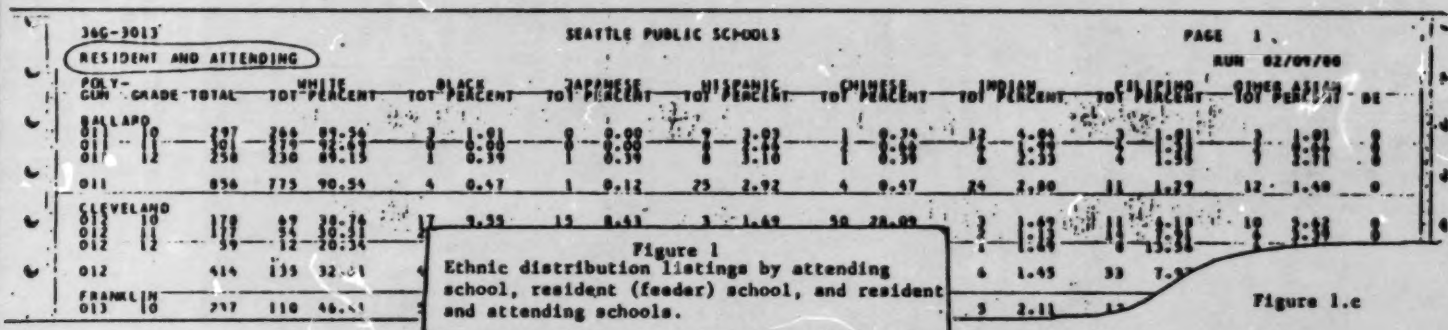
011 1123 992 88.33 15 1.34 3 0.27 37 3.29 6 0.53 41 3.65 13 1.16 16 1.42 0
CLEVELAND
012 669 220 32.88 87 13.00 69 10.31 16 2.39 176 26.31 10 1.49 55 8.22
FRANKLIN
013 249 111 44.47 68 27.28 12 4.46 10 3.72 21 7.81 3 1.86 14

Figure 1.b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BALLARD
011 856 775 90.54 4 0.47 1 0.12 25 2.92 4 0.47 24 2.80 11 1.29 12 1.40 0
CLEVELAND
012 414 135 32.61 6 1.45 33 7.97
FRANKLIN
013 217 110 46.54 5 2.11

Figure 1.c

Figure 1
Ethnic distribution listings by attending school, resident (feeder) school, and resident and attending schools.

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BALLARD 011	TOTAL REG.	WHITE TOT	WHITE PERCENT	BLACK TOT	BLACK PERCENT	JAPANESE TOT	JAPANESE PERCENT	HISPANIC TOT	HISPANIC PERCENT	CHINESE TOT	CHINESE PERCENT	INDIAN TOT	INDIAN PERCENT	FILIPINO TOT	FILIPINO PERCENT	OTHER ASIAN TOT	OTHER ASIAN PERCENT
ENROLLMENT	1123	992	88.33	15	1.34	3	0.27	37	3.29	6	0.53	41	3.65	13	1.16	16	1.42
TOTAL RESIDENT	1021	900	88.15	5	0.49	3	0.29	36	3.53	7	0.69	35	3.43	16	1.57	19	1.86
TOTAL RESIDENT AND ATTENDING	856	775	90.54	4	0.47	1	0.12	25	2.92	4	0.47	24	2.80	11	1.29	12	1.40
TOTAL OUT MIGRANTS	165	125	75.76	1	0.61	2	1.21	11	6.67	3	1.82	11	6.67	5	3.03	7	4.24
% OUT MIGRANTS OF TOT RESIDENT	16.16	13.89		20.00		66.67		30.56		42.86		31.43		31.25		36.84	
IN MIGRANTS	267	217	81.27	11	4.12	2	0.75	12	4.49	2	0.75	17	6.37	2	0.75	4	1.50
% IN MIGRANTS OF ENROLLMENT	23.78	21.88		73.33		66.67		32.43		33.33		41.46		15.38		25.00	
CLEVELAND 013																	
ENROLLMENT	669	220	32.88	87	13.00	69	10.31	16	2.39	176	26.31	10	1.49	55	8.22	36	5.38
TOTAL RESIDENT	843	317	37.60	134	15.90	50	5.93	30	3.56	193	22.89	27	3.20	50	5.93	42	4.98
TOTAL RESIDENT AND ATTENDING	414	135	32.61	44	10.63	34	8.21	11	2.66	131	31.64	6	1.45	33	7.97	20	4.83
TOTAL OUT MIGRANTS	488	247	50.63	99	22.08	16	3.32	18	9.69	57	16.69	21	6.89	17	2.88	23	9.12
% OUT MIGRANTS OF TOT RESIDENT	35.20	36.27		49.88		47.06		38.10		61.67		67.44		26.19		31.65	
IN MIGRANTS	443	111	25.06	208	46.95	1	0.23	13	.93	0	0.00	16	3.61	13	2.93	81	18.28
% IN MIGRANTS OF ENROLLMENT	36.31	16.32		80.31		10.00		33.33		0.00		93.33		29.55		68.08	
QUEEN ANNE 016																	
ENROLLMENT	893	566	63.38	94	10.53	21	2.35	25	2.80	85	9.52	13	1.46	32	3.58	57	6.38
TOTAL RESIDENT	830	579	69.76	88	10.60	32	3.86	21	2.53	36	4.32	8	0.96	29	3.49	17	2.05
TOTAL RESIDENT AND ATTENDING	495	472	79.33	37	6.22	15	2.52	14	2								84
TOTAL OUT MIGRANTS	235	107	45.53	51	21.70	17	7.23	5	2								11
% OUT MIGRANTS OF TOT RESIDENT	28.31	18.48		57.95		53.13		23.81									
IN MIGRANTS	298	94	31.54	57	19.13	6	2.01	9	3.02	58	19.46	8	2.68	14	4.70	52	17.45
% IN MIGRANTS OF ENROLLMENT	33.37	16.61		60.64		28.57		36.00		68.24		61.54		43.75		91.23	

Figure 2
Ethnic distribution summary data comparing enrollment counts against resident students and out-of-feeder students

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CENSUS TRACT WITHIN NEIGHBORHOOD-K

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NEIGHBORHOOD-K	CENSUS TRACT	TOTAL	% OF CENSUS TRACT
201 ADAMS			
207 ALKI			
203 ARBOR HEIGHTS			

Figure 3.a

SEATTLE PUBLIC SCHOOLS

CENSUS TRACT SUMMARY REPORT

REPORT 36G-3071 05/14/79 PAGE 2

CENSUS TRACT	GRADE	TOTAL	WHITE TOT	WHITE PERCENT	BLACK TOT	BLACK PERCENT	HISPANIC TOT	HISPANIC PERCENT	INDIAN TOT	INDIAN PERCENT	CHINESE TOT	CHINESE PERCENT	FILIPINO TOT	FILIPINO PERCENT	JAPANESE TOT	JAPANESE PERCENT	OTHER ASIAN TOT	OTHER ASIAN PERCENT
22		726	643	88.84	18	2.48	11	1.52	1	0.14	19	2.62	6	0.83	19	2.62	7	0.96
23		6	6	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00		
24		351	309	88.03	1	0.28	6	1.71	5	1.42	6	1.71	4	1.14				
25		165	150	90.91	3	1.82	3	1.82	1	0.61	5	3.03	1	0.61				

Figure 3.b

SEATTLE PUBLIC SCHOOLS

NEIGHBORHOOD-K BY GRADE WITHIN CENSUS TRACT

CENSUS TRACT 1

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NEI-K	GRADE	TOTAL	WHITE TOT	WHITE PERCENT	BLACK TOT	BLACK PERCENT	HISPANIC TOT	HISPANIC PERCENT	INDIAN TOT	INDIAN PERCENT	CHINESE TOT	CHINESE PERCENT	FILIPINO TOT	FILIPINO PERCENT	JAPANESE TOT	JAPANESE PERCENT	OTHER ASIAN TOT	OTHER ASIAN PERCENT
210	CEDAR PARK																	
	00	14	10	71.43	0	0.00	0	0.00	0	0.00	0	0.00	2	14.29	0	0.00	2	14.29
	01	23	20	86.96	0	0.00	1	4.35	1	4.35	0	0.00	0	0.00	1	4.35	0	0.00
	02	28	25	89.29	1	3.57	0	0.00	0	0.00	0	0.00	1	3.57	0	0.00	1	3.57
	03	27	22	81.48	1	3.70	0	0.00	0	0.00	0	0.00	1	3.70	0	0.00	1	3.70
	04	29	28	96.55	1	3.45	0	0.00	0	0.00	0	0.00						
	05	23	23	92.00	0	0.00	0	0.00	0	0.00	0	0.00						
	06	35	32	91.43	1	2.86	0	0.00	0	0.00	1	2.86						
	07	29	24	82.76	0	0.00	0	0.00	0	0.00	1	3.45						
	08	28	22	78.57	3	10.71	0	0.00	0	0.00	0	0.00						
	09	36	28	77.78	2	5.56	0	0.00	0	0.00	0	0.00						
	10	39	33	84.62	0	0.00	1	2.56	0	0.00	0	0.00						
	11	42	36	85.71	4	9.52	1	2.38	0	0.00	0	0.00						
	12	43	38	88.37	0	0.00	0	0.00	0	0.00	1	2.33	1	2.33	0	0.00	0	0.00
210	TOTAL	398	341	85.68	13	3.27	3	0.75	1	0.25	3	0.75	5	1.26	16	4.02		
240	LAKE CITY																	
	00	5	2	40.00	0	0.00	0	0.00	0	0.00	2	40.00	0					
	01	9	6	66.67	1	11.11	0	0.00	0	0.00	0	0.00	0					
	02	11	8	72.73	0	0.00	1	9.09	0	0.00	0	0.00						

RESIDENT STUDENT DATA BY CENSUS TRACTS

Figure 3

Figure 3.c

cessing program and area codes are appended to records whose xy coordinates lie within the polygons. This capability is the key to the District's long success with geocoding. In fact, attendance area codes in the GSMF are geocoded in this way. Sets of polygons currently used are for transportation, enrollment projections, school closure, boundary alignment and for ad hoc simulations of current data with historical areas. Network node code, or map/node, is the closest network point for the student's address. Map/nodes allow data to be aggregated to points on a network, and to conduct network analysis of such data. A pedestrian network developed for the District is used in a minimum path assignment program to compute network distances from map/nodes to schools. Applying a student's map/node to the distance file, the closest 4 elementary, 3 middle, and 3 senior high schools and their distances are obtained and appended to the student's GSMF record. Network distance data have been used for facilities planning and transportation activities. Applications of geocoded data at the Seattle School District were presented by William A. Collison at the 1973 URISA conference.

Although the GEOBASYS Geographic Base File (GBF) has not been updated since 1976, the geocodes on the student file are current because manual overrides have been built into the weekly update system. Contacts with city agencies keep the District abreast of new street developments, new housing areas and street modifications. To upgrade student data files with advances in software technology, discussions are underway to develop an integrated student data base. When completed, the student file and GBF (also in database form) will be linked with a data base management system.

Graphics

Computer generated graphics are an integral part of geoprocessing. The plots allow users to visualize their data. The repertoire of plotter graphics currently available at the District includes the following types of plots used for various projects:

1. Variable-X plots are generally used to illustrate student distributions for specific criteria. Districtwide racial distribution (Appendix 1 to 5), distribution by special programs, distribution by school, or by grade are just samples of requests for these plots. These plots are the most popular type to include in reports.

2. Point plots with numbers and/or symbols are used generally for displaying numbers of students aggregated under specific criteria. Point plots of students in proposed school closure areas have been invaluable for planning closure simulation models. (Appendix 6). These plots have students from the appropriate grade levels plotted at a large scale to overlay street maps available from the city engineering department. Point plots are also useful for displaying bus routes and stops and facilities locations (Appendix 7).

3. Polygon plots are used for various purposes: to illustrate how the District is divided by a set of polygons, to outline point plots for specific polygon areas, (Appendix 8 and 9) and for visual edits during the polygon development phase (Appendix 10). Polygons can be plotted individually, in groups, or in total as needed. Sets of polygons currently available are neighborhood-Ks, census tracts, SPUs and LPUs, bus stop areas and transportation's non-eligibility areas.

4. Shaded polygon plots show variations in data by the shading gradations of the polygon areas. These are plotted with percentages or with actual range of values (Appendix 11).

5. Network plots are available for all segments in the G3F, pedestrian network, arterials, and in subsets of areas by map numbers (Appendix 12), polygons, or coordinate definitions. By combining a vehicular network plot with point plots transportation route-by-stops maps can be produced in the future.

Desegregation

In the mid-70's, the effects of court ordered bussing were reverberating throughout the country in large urban public school districts. The Seattle School District, wanting to avoid the chaos of a court directive, decided to study the issue in depth. Because of the in-house capabilities of geocoding, a residence-based desegregation plan was possible and, in 1978, the District voluntarily elected to implement "The Seattle Plan" without a court order. The central idea of the residence-based school assignment plan was to move groups of students by neighborhoods to obtain racial balance in the schools. To accomplish this, all students were geocoded to their neighborhood elementary attendance areas.. A 13-year grade level progression of schools was defined as the assignment or feeder pattern for each attendance area. Because kindergartners were exempt from the desegregation plan the attendance areas were renamed neighborhood-kindergarten areas, or "neighborhood-Ks". At the elementary level, schools with predominantly white populations were paired with schools from predominantly non-white neighborhoods such that students from both areas were to attend one of the paired schools for grades 1-3 and the other for grades 4-6. At the secondary levels, racial balance was attempted through selections of neighborhood-Ks feeding into each secondary school. "Grandfather" options were offered to students already in secondary schools to remain in their schools. An example of a senior high attendance area is shown in figure 4.

The Seattle Plan couples the mandatory residence-based school assignment plan with voluntary transfer options. Students are allowed transfers to option programs in schools other than their

SEATTLE PUBLIC SCHOOLS

Cleveland Sr. High School Attendance Area 1983-84

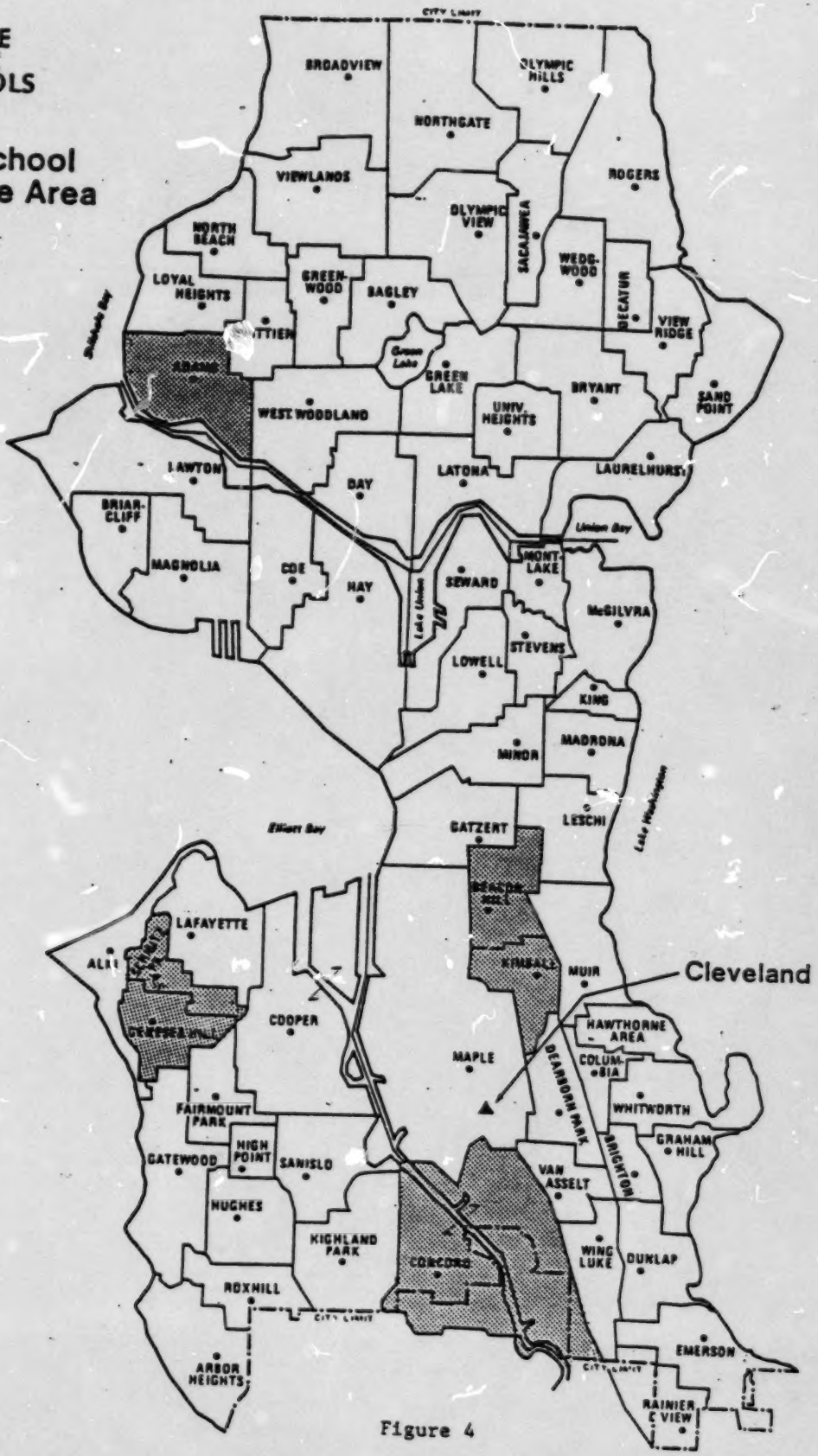

Figure 4

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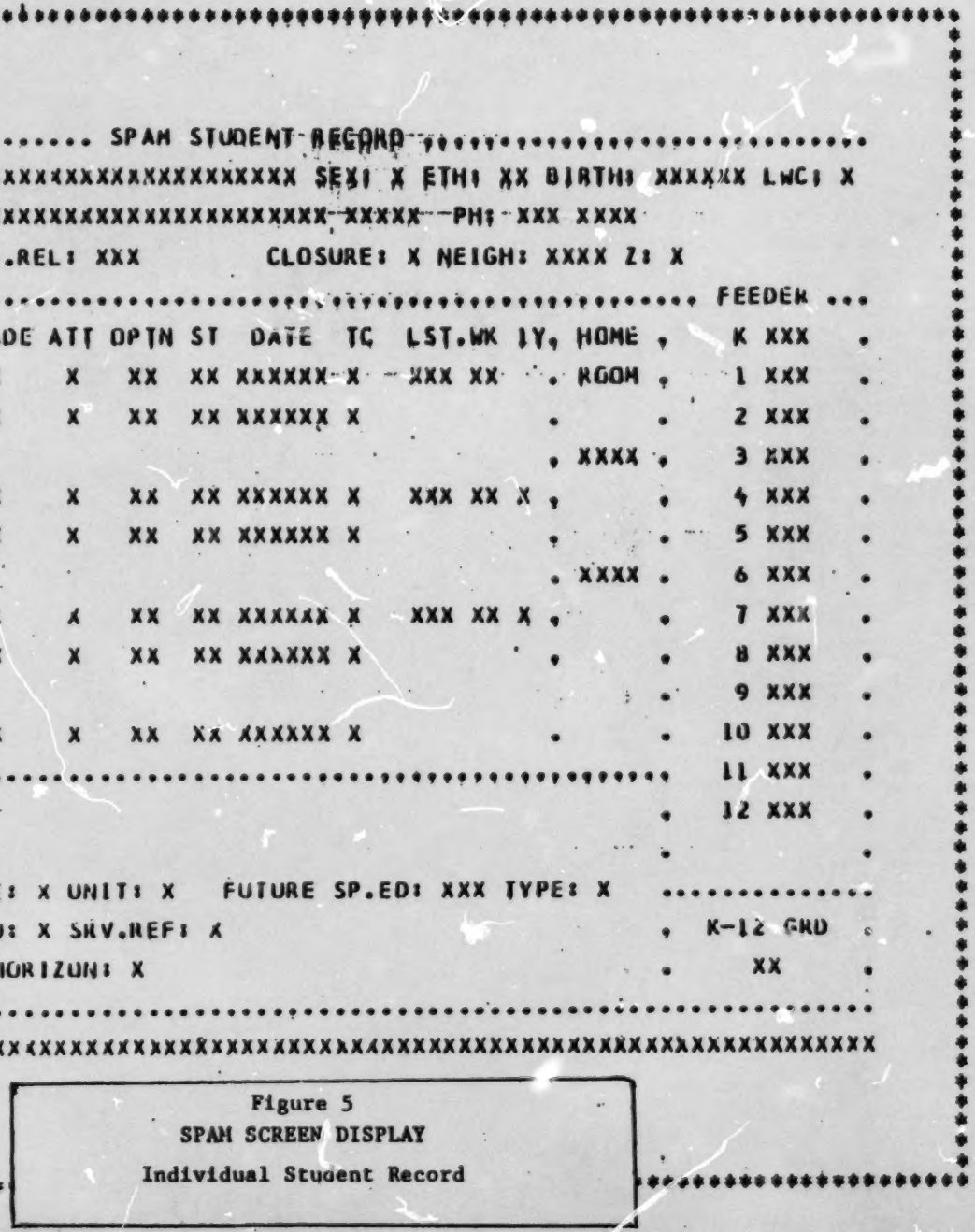
SPAM STUDENT RECORD
ID: XXXXXX NAME: XXXXXXXXXXXXXXXXXXXXXXXX SEX: X ETH: XX BIRTH: XXXXXX LWC: X
ADDR: XXXXXXXXXXXXXXXXXXXXXXXXX XXXXX PH: XXX XXXX
DC: X REL.REA: XXX FUT.REL: XXX CLOSURE: X NEIGH: XXXX Z: X
SCHOOL GRADE ATT OPTN ST DATE TC LST.WK IY HOME
CURRENT: XXX XX X XX XX XXXXXX X XXX XX ROOM
FROZEN: XXX XX X XX XX XXXXXX X
-THIS YR-
PLACEMENT: XXX XX X XX XX XXXXXX X XXX XX X
REQUESTED: XXX XX X XX XX XXXXXX X
-NEXT YR-
PLACEMENT: XXX XX X XX XX XXXXXX X XXX XX X
REQUESTED: XXX XX X XX XX XXXXXX X
PREVIOUS: XXX XX X XX XX XXXXXX X
COMP.ED: XXXX
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K XXX
1 XXX
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Figure 5
SPAM SCREEN DISPLAY
Individual Student Record

feeder schools if the move aids the desegregation effort. An interactive Student Placement Activity Master file (SPAM), was created to handle the tremendous level of bookkeeping chores required by this plan. An example of a SPAM screen display for an individual student is shown in figure 5. The critical element of SPAM is the neighborhood-K for monitoring and analyzing student movement away from assigned feeder patterns. In addition, SPAM carries previous year and following year's data along with current year's to facilitate student placement analyses over a 3 year span. To accommodate the future neighborhood-K assignments, a second set of polygons is allowed in the normal processing of SPAM. This capability allows for simulating contemplated school closures and feeder pattern or boundary changes. The Seattle Plan is still in effect, having observed its 6th anniversary.

The availability of reports generation software such as SPSS, MRCS and a report writer for SPAM on the District computer, along with the installation of terminals in administrative offices has allowed users to obtain their own tailored reports (figures 6 to 8) using GSMF and SPAM data, and merging these with data from other files such as bilingual, discipline and testing, without relying on the data processing department. This has been a great advantage for planners, evaluators and administrators.

Facilities Utilization

Declining enrollment was another major issue for the District during the 70's. Aging school buildings and half empty schools necessitated the decision to close a number of schools, a decision which closely followed implementation of the desegregation plan. Thus, to minimize disruption for students already moved for desegregation purposes, facilities planners were required to scrutinize their closure plans with care. For elementary school closures, proximal school data for students in proposed closure areas were studied initially to see if adjacent schools could accommodate the distribution. (Assignment to proximal schools would minimize transportation requirements.) Reports were analyzed for ethnic distribution and for students with special program needs. Plots were generated and tentative boundary lines were drawn taking into account physical barriers and safety concerns. Polygons were developed according to tentative boundary lines. Simulated student data from GSMF and SPAM were again analyzed. These steps were repeated as often as necessary, incorporating recommendations from other administrative offices and the community. When the final decision was made, six elementary schools were closed in 1978, the second year of the desegregation plan, with minimal disruption to the local communities. An additional 15 schools were closed two years later. Geoprocessing technology is a necessary tool for facilities planning as long as schools continue to be closed, and in some instances, reopened. Present concerns are for temporary closures of schools requiring renovations, and their reopenings.

NEIGCURR: 11 BALLARD

CROSSTABULATION OF ETHGROUP BY GRDC

CONTROLLING FOR.. PERMSTAT VALUE = 3. TRNSF OUT

ETHGROUP	GRDC 9	10	11	12	ROW TOTAL
HISPANIC (1)	3	1	2	4	10
	30.0	10.0	20.0	40.0	5.1
	4.4	2.2	4.4	10.3	
WHITE (2)	28	23	18	22	91
	30.8	25.3	19.8	24.2	46.0
	41.2	50.0	40.0	56.4	
BLACK (3)	21	16	7	6	50
	42.0	32.0	14.0	12.0	25.3
	30.9	34.8	15.6	15.4	
AMER. INDIAN (4)	6	2	3	1	12
	50.0	16.7	25.0	8.3	6.1
	8.8	4.3	6.7	2.6	
ASIAN (5)	10	4	15	6	35
	28.6	11.4	42.9	17.1	17.7
	14.7	8.7	33.3	15.4	
COLUMN TOTAL	68	46	45	39	198
	34.3	23.2	22.7	19.7	100.0

NUMBER OF MISSING OBSERVATIONS = 0

Resident students of Ballard High School not attending Ballard, by grade and ethnicity

NEIGCURR: 11 BALLARD

CROSSTABULATION OF GENOPTC BY ETHGROUP

CONTROLLING FOR.. SCHC VALUE = 11. BALLARD

GENOPTC	ETHGROUP HISPANIC 1	WHITE 2	BLACK 3	AMER. INDIAN 4	ASIAN 5	ROW TOTAL
MULTI-ARTS (11)		6	1		4	11
		54.5	9.1		36.4	1.1
		.8	3.7		2.8	
NEIGH FEED SCH A (66)	24	666	19	13	57	779
	3.1	85.5	2.4	1.7	7.3	80.3
	85.7	88.2	70.4	68.4	40.4	
TRANSFER THRU HI (67)		1			1	2
		50.0			50.0	.2
		.1			.7	
SPECIAL ED. (70)	1	37	3	3	1	45
	2.2	82.2	6.7	6.7	2.2	4.6
	3.6	4.9	11.1	15.8	.7	
RACIAL TRANS THR (78)					2	2
					100.0	.2
					1.4	
TRANSFERRD THRU (79)		1				1
		100.0				.1
		.1				
HAVE TO PROVE AD (91)		1				1
		100.0				.8
		1.1				
----- --- (99)		2				2

Students attending Ballard by Option Code.

Figure 6

NEIGH: 226 GATZERT

CROSSTABULATION OF SCHC BY LANGROUP PAGE 1 OF 1

SCHC	COUNT	CHINESE 11	PHILIPPINE 21	KOREAN 81	SPANISH 91	VIETNAMESE 441	CAMBODIAN 501	LAO-HMONG 521	OTHER LANG 991	ROW TOTAL
EAGLEY	204					5				5 6.3
COE	211	21						1		22 27.8
DAY	218							1		1 1.3
GATZERT	226	11	1			2		2	1	17 21.5
GREENWOOD	230					2	2	2		6 7.6
LATONA	241					1	1			2 2.5
LAURELHURST	242	1				4		4		9 11.4
LAWTON	243		2		1					3 3.8
LOWELL	245		1	1		1		2	1	6 7.6
SCHMITZ PK	270	1								1 1.3
VIEW RIDGE	277	6								6 7.6
K-PBALL	288	1								1 1.3
	COLUMN TOTAL	41 51.9	4 5.1	1 1.3	1 1.3	15 19.0	3 3.8	12 15.2	2 2.5	79 100.0

NUMBER OF MISSING OBSERVATIONS = 1

Figure 7

Bilingual Students attending Gatzert from other neighborhood-K areas listed by language groups

POLY-CON	GRADE	TOTAL	WHITE TOT	WHITE PERCENT	BLACK TOT	BLACK PERCENT	JAPANESE TOT	JAPANESE PERCENT	HISPANIC TOT	HISPANIC PERCENT	CHINESE TOT	CHINESE PERCENT	INDIAN TOT	INDIAN PERCENT	FILIPINO TOT	FILIPINO PERCENT	OTHER ASIAN TOT	OTHER ASIAN PERCENT	BE
LOWELL																			
245	00	40	19	47.50	11	27.50	0	0.00	3	7.50	0	0.00	2	5.00	1	2.50	4	10.00	0
245	01	31	16	51.61	5	16.13	0	0.00	2	6.45	0	0.00	1	3.23	0	0.00	3	9.68	0
245	02	30	18	60.00	5	16.67	1	3.33	2	6.67	0	0.00	1	3.33	0	0.00	3	10.00	0
245	03	23	14	60.87	3	13.04	2	8.70	0	0.00	0	0.00	1	4.35	0	0.00	1	4.35	0
245	04	26	18	69.23	4	15.38	1	3.85	1	3.85	0	0.00	1	3.85	0	0.00	1	3.85	0
245	05	35	17	48.57	4	11.43	2	5.71	1	2.86	1	2.86	3	8.57	0	0.00	1	2.86	0
245	06	31	17	54.84	2	6.45	0	0.00	1	3.23	1	3.23	3	9.68	0	0.00	4	12.90	0
245	07	33	22	66.67	3	9.09	0	0.00	1	3.03	1	3.03	2	6.06	0	0.00	4	12.12	0
245	08	41	25	60.98	3	7.32	0	0.00	1	2.44	1	2.44	2	4.88	0	0.00	6	14.63	0
245	09	36	18	50.00	4	11.11	0	0.00	1	2.78	5	13.89	1	2.78	0	0.00	6	16.67	0
245	10	42	20	47.62	4	9.52	0	0.00	1	2.38	1	2.38	2	4.76	0	0.00	9	21.43	0
245	11	22	6	27.27	3	13.64	0	0.00	0	0.00	1	4.55	1	4.55	0	0.00	11	50.00	0
245	12	38	18	47.37	3	7.89	0	0.00	0	0.00	2	5.26	0	0.00	1	2.63	14	36.84	0
245		430	228	53.02	54	12.56	6	1.40	22	5.12	20	4.65	24	5.58	2	0.47	74	17.21	0
LOYAL HEIGHTS																			
246	00	49	43	87.76	3	6.12	1	2.04	0	0.00	1	2.04	0	0.00	0	0.00	1	2.04	0
246	01	51	41	80.39	0	0.00	1	1.96	3	5.88	3	5.88	2	3.92	0	0.00	0	0.00	0
246	02	41	33	80.49	1	2.44	0	0.00	3	7.32	3	7.32	1	2.44	0	0.00	0	0.00	0
246	03	48	45	93.75	0	0.00	0	0.00	3	6.25	0	0.00	0	0.00	0	0.00	0	0.00	0
246	04	22	19	86.36	0	0.00	0	0.00	2	9.09	0	0.00	0	0.00	0	0.00	0	0.00	0
246	05	48	42	87.50	1	2.08	0	0.00	1	2.08	2	4.17	0	0.00	1	2.08	1	2.08	0
246	06	34	31	91.18	0	0.00	0	0.00	1	2.94	0	0.00	1	2.94	0	0.00	1	2.94	0
246	07	40	34	85.00	0	0.00	1	2.50	0	0.00	1	2.50	1	2.50	1	2.50	1	2.50	0
246	08	49	47	95.92	1	2.04	0	0.00	1	2.04	0	0.00	0	0.00	0	0.00	0	0.00	0
246	09	52	43	82.69	1	1.92	0	0.00	3	5.77	0	0.00	3	5.77	1	1.92	1	1.92	0
246	10	53	44	83.02	0	0.00	0	0.00	3	5.66	0	0.00	0	0.00	1	1.89	3	5.66	0
246	11	48	43	89.58	3	6.25	0	0.00	0	0.00	0	0.00	1	2.08	0	0.00	3	6.25	0
246	12	49	44	89.80	0	0.00	0	0.00	0	0.00	0	0.00	1	2.04	0	0.00	4	8.16	0
246		584	509	87.16	8	1.37	4	0.68	20	3.42	12	2.05	10	1.71	7	1.20	14	2.40	0
MC GILVRA																			
248	00	20	15	75.00	3	15.00	0	0.00	0	0.00	0	0.00	1	5.00	1	5.00	0	0.00	0
248	01	23	15	65.22	1	30.43	0	0.00	0	0.00	1	4.35	0	0.00	0	0.00	0	0.00	0
248	02	25	15	60.00	7	28.00	0	0.00	2	8.00	1	4.00	0	0.00	0	0.00	0	0.00	0
248	03	30	20	66.67	9	30.00	0	0.00	1	3.33	0	0.00	0	0.00	0	0.00	0	0.00	0
248	04	22	18	81.82	2	9.09	0	0.00	0	0.00	1	4.55	1	4.55	0	0.00	0	0.00	0
248	05	24	16	66.67	6	25.00	0	0.00	1	4.17	0	0.00	1	4.17	0	0.00	0	0.00	0
248	06	21	15	71.43	5	23.81	0	0.00	1	4.76	0	0.00	0	0.00	0	0.00	0	0.00	0
248	07	29	19	65.52	6	20.69	0	0.00	1	3.45	0	0.00	0	0.00	0	0.00	0	0.00	0
248	08	25	15	60.00	9	36.00	0	0.00	1	4.00	0	0.00	0	0.00	0	0.00	0	0.00	0
248	09	37	19	51.35	13	35.14	0	0.00	3	8.11	0	0.00	0	0.00	1	2.70	1	2.70	0
248	10	25	15	60.00	8	32.00	0	0.00	0	0.00	0	0.00	0	0.00	2	8.00	0	0.00	0
248	11	21	14	66.67	5	23.81	0	0.00	0	0.00	1	4.76	0	0.00	1	4.76	0	0.00	0
248	12	12	5	41.67	4	33.33	0	0.00	1	8.33	0	0.00	1	8.33	1	8.33	0	0.00	0
248		314	201	64.01	84	26.75	1	0.32	11	3.50	4	1.27	4	1.27	8	2.55	1	0.32	0

Figure 8
RESIDENT STUDENTS BY NEIGHBORHOOD-K

Student Placement

When school closures followed on the heels of the Seattle Plan, the resulting confusion required some quick means for retrieving school assignments by address. Although SPAM properly assigns students to appropriate next-year feeder schools, the Student Placement Office needed a system to handle the deluge of calls immediately following release of closure decisions. The result was the development of an interactive street directory system which displays a 13-year feeder pattern, including any grandfathered options, for an input street address. With this system, Student Placement Office was able to respond quickly to anxious students, parents, school secretaries, real estate offices and the general public who wanted the information.

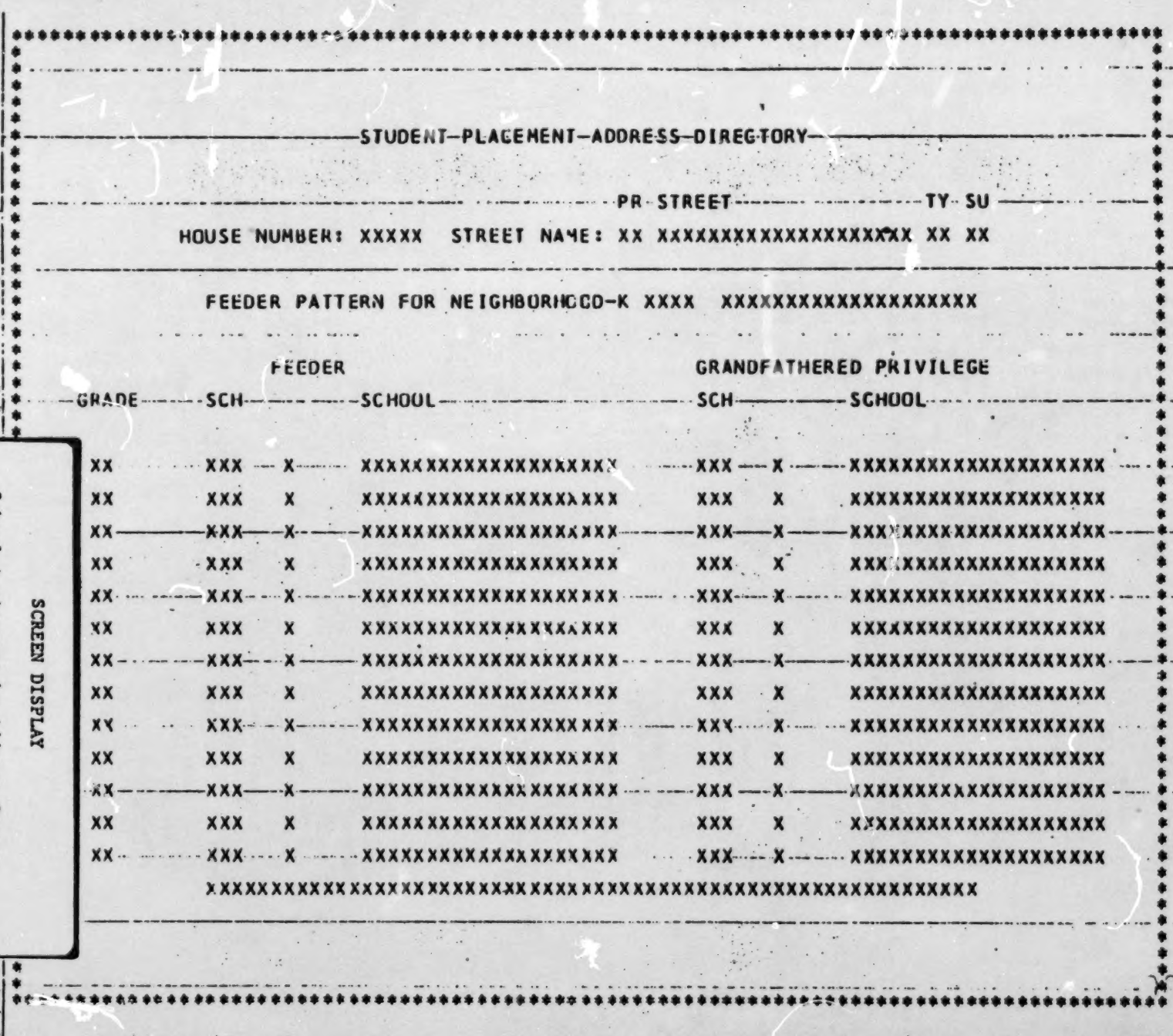
The system was developed by utilizing the point-in-polygon program to assign even and odd sides of all street segments of the GBF to neighborhood-Ks. Address ranges for each street name were consolidated within each polygon to reduce the number of records, and the resulting sequential file was converted to a data base file structure. The file then accesses a feeder table by neighborhood-K. A sample of a *STREET screen display is shown in figure 9. Samples of the printed street directory and feeder pattern table are illustrated in figures 10 and 11. The *STREET capability is the prototype for future interactive systems when the GBF is converted to data base processing.

Enrollment Projection System

An enrollment forecasting system just completed for the District was designed by the University of Washington's Center for Demography and Ecology, utilizing historic and ongoing geocoded data. The need for a new forecasting model became apparent when the desegregation plan's voluntary transfer to option programs produced unpredictable student movement. Previously employed projection methods were inadequate to predict school level enrollment with any precision, especially as demanded by the District's budget process.

Dr. Tom Pullum and Steve Graham of the Center became familiar with the District's store of geocoded data when they produced impressive evidence for the District's court case challenging Initiative 350, the bill which sought to dismantle the desegregation plan and return all students to schools nearest to their homes. Applying linear programming techniques to geocoded data, the pair proved that if students were returned to their neighborhood schools, the schools could not be desegregated.

Pullum and Graham, interested by the prospect of utilizing historic geocoded data with an enrollment forecasting system, conceptualized small geographic areas as building blocks to aggregate up to larger areas such as school attendance areas. The District


STUDENT-PLACEMENT-ADDRESS-DIRECTORY
PR STREET TY SU
HOUSE NUMBER: XXXXX STREET NAME: XX XXXXXXXXXXXXXXXXXX XX XX
FEEDER PATTERN FOR NEIGHBORHOOD-K XXXX XXXXXXXXXXXXXXXXXX
FEEDER
GRADE SCH SCHOOL
GRANDFATHERED PRIVILEGE
SCH SCHOOL
XX XXX X XXXXXXXXXXXXXXXXXX XXX X XXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXX

REPORT: 3AG-3095 1983-84 DIRECTORY OF SCHOOL ASSIGNMENT BY ADDRESS 03/19/83 PAGE:

	STREET NAME	EVEN ADDR	NEI-K	SCHOOL NAME	ODD ADDR	NEI-K	SCHOOL NAME
	FULLERTON AV	600- 704	249B	MADRONA	601- 699	249B	MADRONA
	FULTON ST	2- 398	234N	HAY	1- 399	234N	HAY
W	FULTON ST	2- 98	234M	HAY	1- 99	234N	HAY
W	FULTON ST	300- 398	211N	COE	301- 399	211N	COE
W	FULTON ST	400- 1098	211E	COE	401- 1099	211E	COE
W	FULTON ST	2500- 2798	250	MAGNOLIA	2501- 2799	250	MAGNOLIA
W	FULTON ST	3600- 3798	206	BRIARCLIFF	3601- 3799	206	BRIARCLIFF
	GALE PL S	3300- 3398	256	MUIR	3301- 3399	256	MUIR
	GALER PL N	1500- 1598	234E	HAY	1501- 1599	234E	HAY
	GALER ST	2- 798	234E	HAY	1- 799	234E	HAY
E	GALER ST	200- 298	271	SEWARD	201- 299	271	SEWARD
E	GALER ST	1000- 1098	245	LOWELL	1001- 1099	245	LOWELL
E	GALER ST	1500- 2698	272	STEVENS	1501- 2699	272	STEVENS
E	GALER ST	3700- 4198	248	MC GILVRA	3701- 4199	248	MC GILVRA
W	GALER ST	2- 598	234W	HAY	1- 599	234W	HAY
W	GALER ST	600- 798	211W	COE	601- 799	234W	HAY
W	GALER ST	800- 1098	211W	COE	801- 1099	211W	COE
W	GALER ST	2600- 3198	250	MAGNOLIA	2601- 3199	250	MAGNOLIA
S	GARDEN ST	500- 798	215	CONCORD	501- 799	215	CONCORD
S	GARDEN ST	4600- 5098	207A	BRIGHTON	4601- 5099	207A	BRIGHTON
S	GARDEN ST	5100- 5198	220	GRAHAM HILL	5101- 5199	220	GRAHAM HILL
	GARFIELD ST	2- 798	234E	HAY	1- 799	234E	HAY
E	GARFIELD ST	100- 798	271	SEWARD	101- 799	271	SEWARD
E	GARFIELD ST	1000- 1048	245	LOWELL	1001- 1049	245	LOWELL
E	GARFIELD ST	1500- 2698	272	STEVENS	1501- 2699	272	STEVENS
E	GARFIELD ST	3700- 4298	248	MC GILVRA	3701- 4299	248	MC GILVRA
W	GARFIELD ST	2- 598	234W	HAY	1- 599	234W	HAY
W	GARFIELD ST	600- 1198	211W	COE	601- 1199	211W	COE
W	GARFIELD ST	1400- 1498	211E	COE	1401- 1499	211E	COE
W	GARFIELD ST	2800- 3098	250	MAGNOLIA	2801- 3099	250	MAGNOLIA
	GARLOUGH AV SW	2700- 3198	270	SCHMITZ PARK	2701- 3199	270	SCHMITZ PARK
	GATEWOOD RD SW	7400- 7498	225E	GATEWOOD	7401- 7499	225E	GATEWOOD
	GAY AV W	4500- 4698	243	LAWTON	4501- 4699	243	LAWTON
S	GAZELLE ST	4500- 5098	264	RAINIER VIEW	4501- 5099	264	RAINIER VIEW
S	GAZELLE ST	5700- 5898	221	EMERSON	5701- 5899	221	EMERSON
S	GENESEE ST	2800- 3198	213A	COLUMBIA	2801- 3199	213A	COLUMBIA
S	GENESEE ST	3200- 5098	233	HAWTHORNE AREA	3201- 5099	233	HAWTHORNE AREA
SW	GENESEE ST	1900- 3298	216	COOPER	1801- 3299	216	COOPER
SW	GENESEE ST	3600- 5598	227	GENESEE HILL	3601- 5499	227	GENESEE HILL
	GILMAN AV W	3200- 3298	243	LAWTON	3201- 5199	243	LAWTON
	GILMAN DR W	1900- 2198	211W	COE			
	GILMAN DR W	2200- 2598	211E	COE			
	GILMAN PL W	4200- 4498	243	LAWTON			
E	GLEN ST	1800- 1898	254	MINOR			
W	GLENMONT LN	4200- 4498	206	BRIARCLIFF			
	GLENN WY SW	4400- 4698	227	GENESEE HILL			
	GLENRIDGE WY SW	3900- 7498	225E	GATEWOOD			

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Printed address directory from the interactive school assignment by address system to be used with the feeder assignments listing.

Figure 10

REPORT: 36G-3096 1983-84 DIRECTORY OF FEEDER ASSIGNMENTS AND GRANDFATHERING PRIVILEGES BY NEIGHBORHOOD-K 03/19/83 PAGE:

NEIGHBORHOOD-K	GRADE	FEEDER ASSIGNMENT SCHOOL		GRADE	GRANDFATHERED SCHOOL		
269 SAND POINT	K	269	SAND POINT				
	1	269	SAND POINT				
	2	269	SAND POINT				
	3	269	SAND POINT				
	4	269	SAND POINT				
	5	269	SAND POINT				
	6	104	ECKSTEIN MIDDLE				
	7	104	ECKSTEIN MIDDLE				
	8	104	ECKSTEIN MIDDLE				
	9	017	ROOSEVELT				
	10	017	ROOSEVELT				
	11	017	ROOSEVELT				
	12	017	ROOSEVELT				
270 SCHMITZ PARK	K	270	SCHMITZ PARK				
	1	270	SCHMITZ PARK				
	2	270	SCHMITZ PARK				
	3	270	SCHMITZ PARK				
	4	205 M	BEACON HILL				
	5	205 M	BEACON HILL				
	6	205 M	BEACON HILL				
	7	107	MADISON				
	8	107	MADISON				
	9	012 M	CLEVELAND				
	10	012 M	CLEVELAND				
	11	012 M	CLEVELAND				
	12	012 M	CLEVELAND				
271 SEWARD	K	271	SEWARD				
	1	271	SEWARD				
	2	271	SEWARD				
	3	271	SEWARD				
	4	271	SEWARD				
	5	271	SEWARD				
	6	105	HAMILTON MIDDLE				
	7	105	HAMILTON MIDDLE	7	109	G	MEANY MIDDLE
	8	105 M	HAMILTON MIDDLE	8	109	G	MEANY MIDDLE
	9	014	GARFIELD				
	10	014	GARFIELD				
	11	014	GARFIELD				
	12	014	GARFIELD				
272 STEVENS	K	272	STEVENS				
	1	272	STEVENS				
	2	272	STEVENS				
	3	272	STEVENS				
	4	272	STEVENS				
	5	272	STEVENS				
	6	109	MEANY MIDDLE				
	7	109	MEANY MIDDLE				
	8	109	MEANY MIDDLE				
	9	014	GARFIELD				
	10	014	GARFIELD				
	11	014	GARFIELD				
	12	014	GARFIELD				
273 SANISLO	K	273	SANISLO				
	1	273	SANISLO				
	2	273	SANISLO				
	3	273	SANISLO				
	4	273	SANISLO				
	5	273	SANISLO				
	6	273	SANISLO				
	7	103	DENNY				
	8	103	DENNY				
	9	018	SEALTH				
	10	018	SEALTH				
	11	018	SEALTH				
	12	018	SEALTH				

Feeder assignments listing to be used with printed address directory for school assignments by address

Figure 11

was divided into 600 building blocks called Small Planning Units (SPUs) each containing approximately 50-100 students (figure 12). A stipulation was the SPU areas could not be divided by school boundary lines, past or present, because school attendance areas were to be defined as composites of SPUs. With GSMFs containing residential dwelling geocodes to the x-y coordinate level, past GSMF tapes as well as current student data could be encoded to SPUs by the point-in-polygon processing method. Thus, student data could be analyzed by SPU or larger aggregate areas over time to identify trends or patterns. A paper on the enrollment forecasting model, co-authored by Graham and Dr. Larry Collister, District Demographer, was presented at the 1984 URISA conference.

Transportation

Transportation planners have defined over 1200 transportation polygons as bus stop areas for which bus routes and stops are assigned annually. Additionally, eligibility polygons around each school are defined as areas in which resident students are ineligible for transportation. Student assignment to bus routes and stops are accomplished by point-in-polygon encoding with both sets of polygons. Bus cards, student listings for schools and bus drivers, transportation directories and bus assignment letter for the students are all printed for the start of the school year from the temporary student transportation file just created. When the transportation student file becomes a regularly maintained file, other transportation applications with geoprocessing will be possible such as an interactive bus stop assignment inquiry system and a bus routing and scheduling package.

Bus stops are coded to street intersections with GEOBASYS coordinates (figure 13). When the state required individual maps of bus routes per school, the District responded with point plots of bus stops identified by symbols and numbers plotted at a scale to overlay a City of Seattle Engineering map for each school (Appendix 7). When the State recently requested a report on straightline distances of students to schools, and students to bus stops to calculate its transportation reimbursement formula, these data were readily generated from bus stop, student residence and school location coordinates which were all available.

CONCLUSION

In conclusion, geoprocessing at the Seattle School District can be summarized as follows:

- Geoprocessing is not a narrowly defined system dedicated to a single function. Rather, it is a multi-faceted technology whose activities underpin many of the major student data processing systems serving desegregation, facilities planning, student placement, student

transportation, and student enrollment projection efforts today.

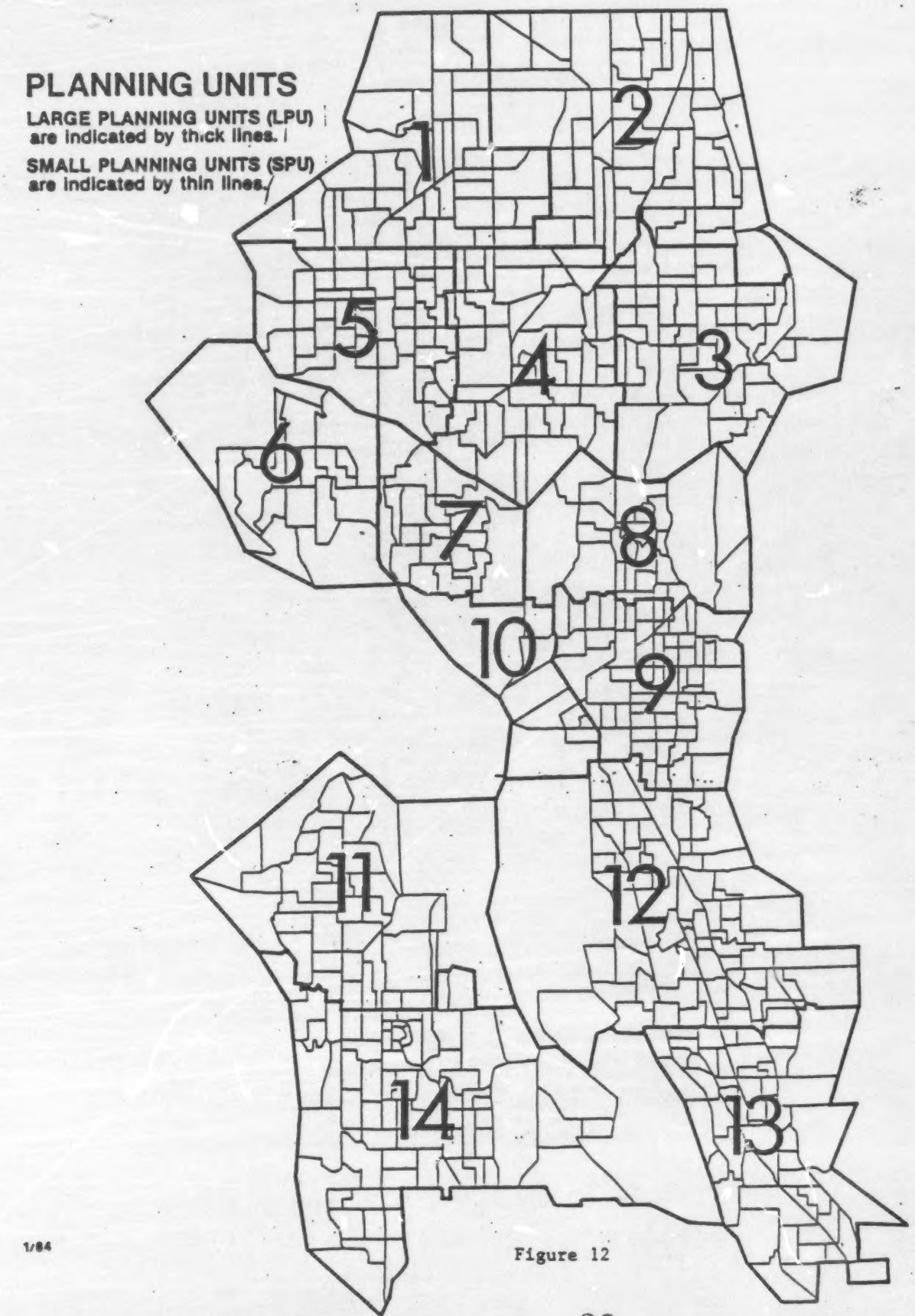
- Geoprocessing was the impetus that gave the District hope in solving its seemingly insurmountable problems of the 70's: racially impacted schools, declining enrollment, aging facilities, and mandatory bussing while faced with limited resources

- Geoprocessing is so deeply embedded in ongoing activities and procedures that its continuation is now assured.

- The geocoding system needs upgrading due to technological changes in hardware and software. Discussions are underway for reviewing the needs.

- Geoprocessing is a sophisticated technology that is difficult to grasp especially at the detail level. The simple products such as point plots and polygons belie the complexity of data generation and information flow required to produce the results.

- The Seattle School District continues to lead the field in its extensive practical applications of geoprocessing technology. The District is understandably proud of its accomplishments.



1/84

Figure 12

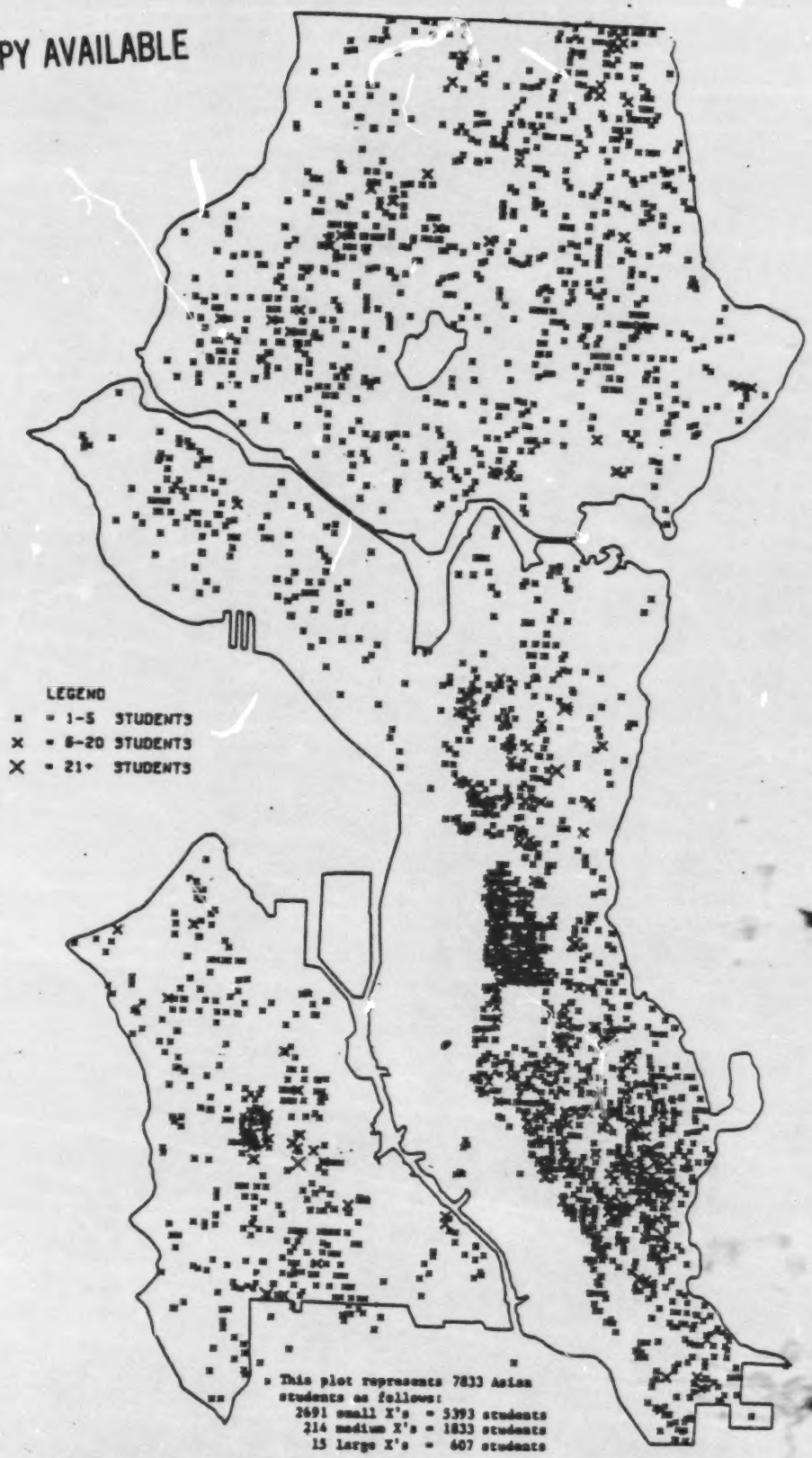
1982-83 ELEMENTARY SCHOOL ROUTES/STOPS BY SCHOOL BY DISTANCE 04/22/82 PAGE 3

ROUTE/STOP		R-DIST MILE	CORNER	MAP	NODE	XCOOR	YCOOR	LEVEL	SCHOOL	TIME	AVENUE	STREET	R-MILE
400	K	4.30	NE	22	570	2654	15280		226	828	FREMONT AV N	N 40 ST	4
400	L	4.60	NE	22	537	2548	15412		226	830	PHINNEY AV N	N 43 ST	4
400	M	4.90	SE	15	751	2561	15582		226	832	PHINNEY AV N	N 48 ST	4
400	N	4.95	SE	13	721	2625	15634		226	832	EVANSTON AV N	N 50 ST	4
400	O	4.86	SW	13	336	2796	15630		226	834	WOODLAND PARK AV N	N 50 ST	4
738	A	6.05	SE	12	508	2020	16018		226	820	15 AV NW	NW 64 ST	6
738	B	6.33	NE	2	332	2011	16175		226	821	15 AV NW	NW 70 ST	6
738	C	6.44	NE	2	315	2013	16242		226	822	15 AV NW	NW 73 ST	6
738	D	6.67	NE	2	134	2012	16376		226	823	15 AV NW	NW 77 ST	6
738	E	6.67	SW	2	134	2013	16376		226	828	15 AV NW	NW 77 ST	6
738	F	6.44	SW	2	315	2013	16242		226	828	15 AV NW	NW 73 ST	6
738	G	6.33	SW	2	332	2011	16175		226	829	15 AV NW	NW 70 ST	6
738	H	6.05	SW	12	508	2020	16018		226	830	15 AV NW	NW 64 ST	6
739	A	7.09	SE	230	357	1940	16580		226	823	18 AV NW	NW 85 ST	7
739	B	7.00	SE	231	742	2052	16577		226	825	MARY AV NW	NW 85 ST	7
739	C	6.91	SE	231	746	2177	16575		226	826	11 AV NW	NW 85 ST	6
739	D	6.60	SW	3	522	2283	16439		226	828	8 AV NW	NW 80 ST	6
739	E	6.37	NW	3	701	2280	16305		226	828	8 AV NW	NW 75 ST	6
739	F	6.27	SW	3	722	2279	16250		226	829	8 AV NW	NW 73 ST	6
739	G	6.31	SW	3	756	2275	16105		226	830	8 AV NW	NW 67 ST	6
		TOTAL STOPS FOR GATZERT =							30				
227 GENESEE HILL													
740	A	4.24	SW	44	331	3475	12935		227	830	14 AV S	S JUDKINS ST	4
740	B	4.24	SW	44	331	3475	12935		227	830	14 AV S	S JUDKINS ST	4
740	C	4.07	NW	51	131	3475	12679		227	831	14 AV S	S HILL ST	4
740	D	4.07	NW	51	131	3475	12679		227	831	14 AV S	S HILL ST	4
741	A	4.63	SE	42	537	3561	13214		227	822	16 AV S	S JACKSON ST	4
741	B	4.84	SE	45	543	3690	13213		227	825	20 AV S	S JACKSON ST	4
741	C	4.81	NW	45	734	3783	12942		227	826	23 AV S	S NORMAN ST	4
741	D	4.71	NW	45	769	3775	12858		227	827	21 AV S	S ATLANTIC ST	4
741	E	4.71	NW	45	769	3775	12858		227	827	21 AV S	S ATLANTIC ST	4
741	F	4.53	SW	45	762	3673	12861		227	828	RAINIER AV S	S ATLANTIC ST	4
741	G	4.55	SW	52	517	3707	12793		227	829	RAINIER AV S	S STATE ST	4
		TOTAL STOPS FOR GENESEE HILL =							11				
234 HAY													
733	A	6.98	SW	66	739	4286	11338		234	820	42 AV S	S RAYMOND ST	6
733	B	7.77	SW	73	303	4231	10995		234	822	RAINIER AV S	S MYRTLE ST	7
733	C	7.79	NW	73	325	4414	10928		234	823	46 AV S	S OTHELLO ST	7
734	A	7.42	SW	73	130	4391	11130		234	820	45 AV S	S HOLLY ST	7
734	B	7.41	NE	73	528	4227	11065		234	821	EMPIRE WY S	S WILLOW ST	7

Sample of bus routes and stops listing by elementary schools including straightline distances of stops to school.

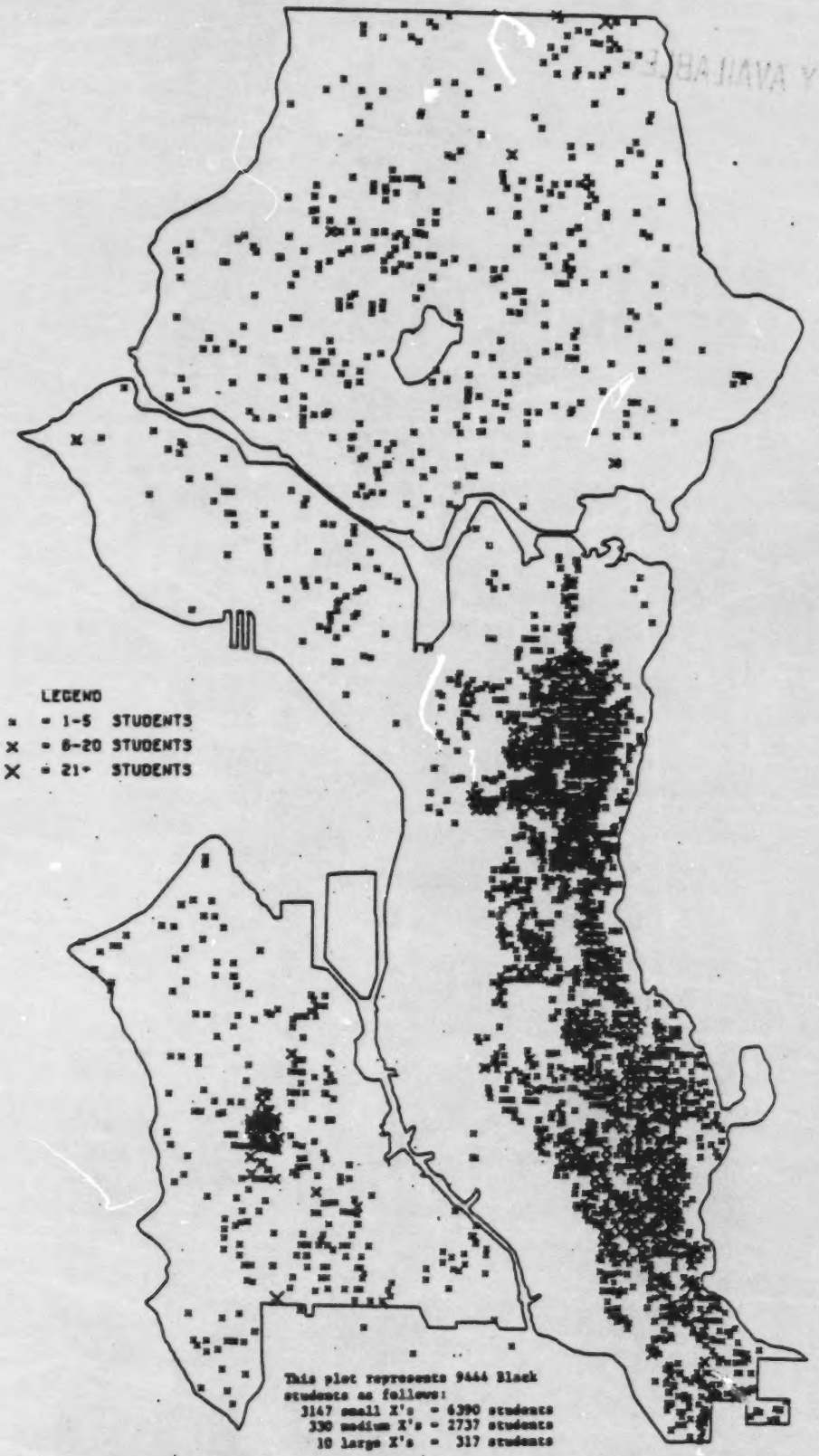
Figure 13

BEST COPY AVAILABLE


LEGEND
· = 1-5 STUDENTS
× = 6-20 STUDENTS
X = 21+ STUDENTS
This plot represents 7833 Asian students as follows:
2691 small X's = 5393 students
214 medium X's = 1833 students
15 large X's = 607 students

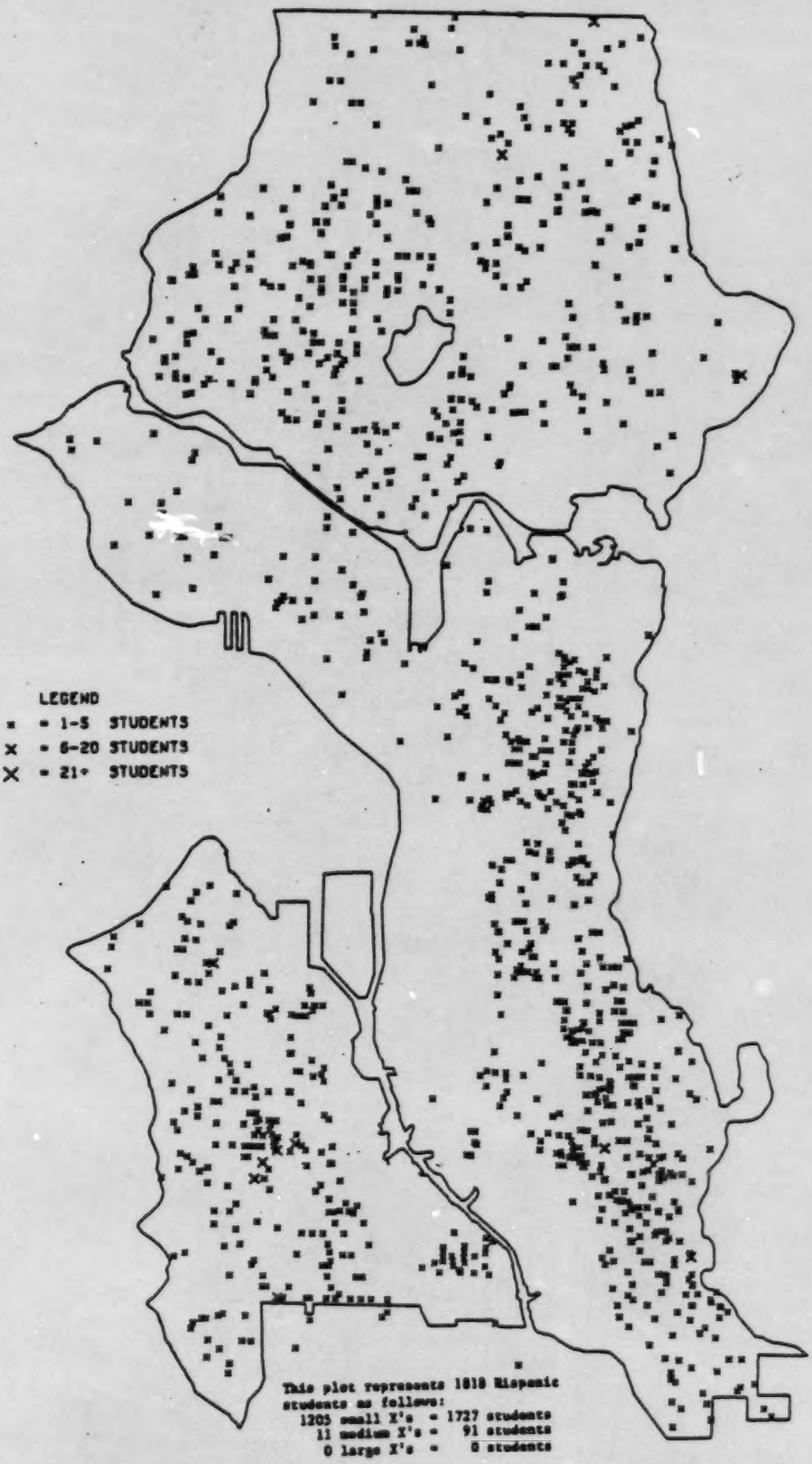
Appendix 1

RESIDENCES OF ASIAN STUDENTS IN SSD JUNE 1983


LEGEND
• = 1-5 STUDENTS
× = 6-20 STUDENTS
X = 21+ STUDENTS
This plot represents 9444 Black students as follows:
3147 small X's = 6390 students
330 medium X's = 2737 students
10 large X's = 317 students

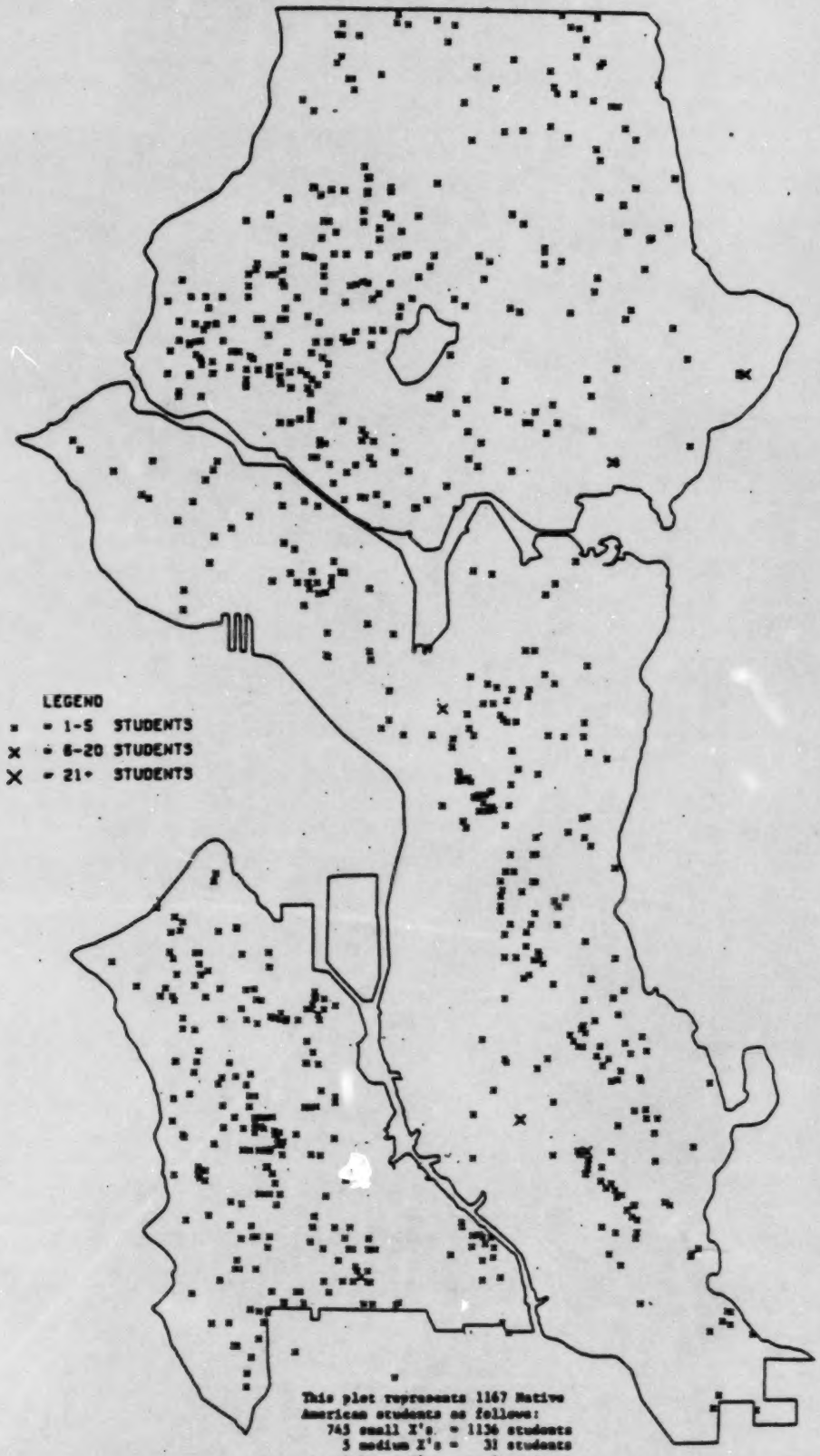
Appendix 2

RESIDENCES OF BLACK STUDENTS IN SSD JUNE 1983


LEGEND
· = 1-5 STUDENTS
× = 6-20 STUDENTS
X = 21+ STUDENTS
This plot represents 1818 Hispanic students as follows:
1205 small X's = 1727 students
11 medium X's = 91 students
0 large X's = 0 students

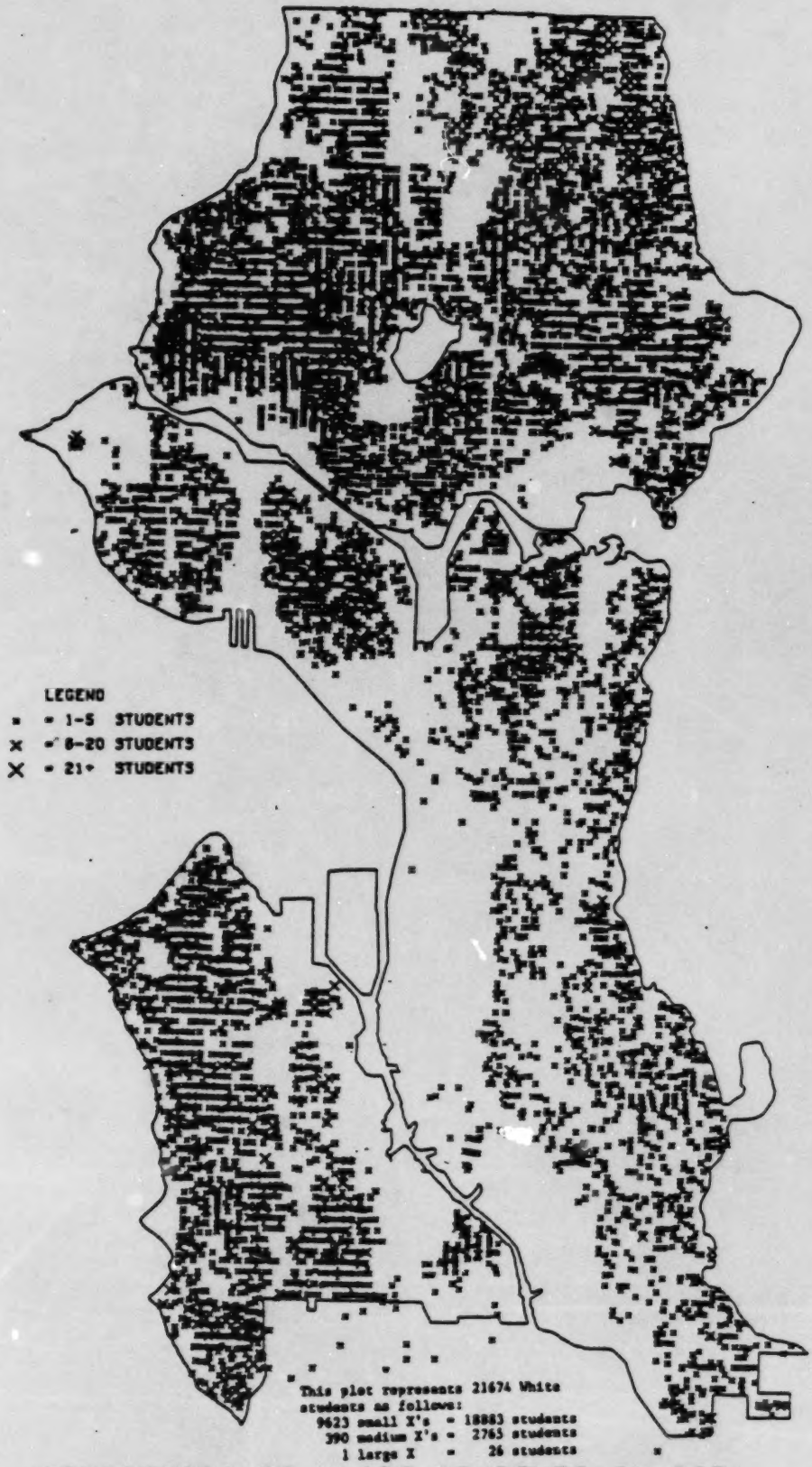
Appendix 3

RESIDENCES OF HISPANIC STUDENTS IN SSD JUNE 1983


LEGEND
= 1-5 STUDENTS
= 6-20 STUDENTS
= 21+ STUDENTS
This plot represents 1167 Native American students as follows:
743 small X's = 1136 students
5 medium X's = 31 students
0 large X's = 0 students

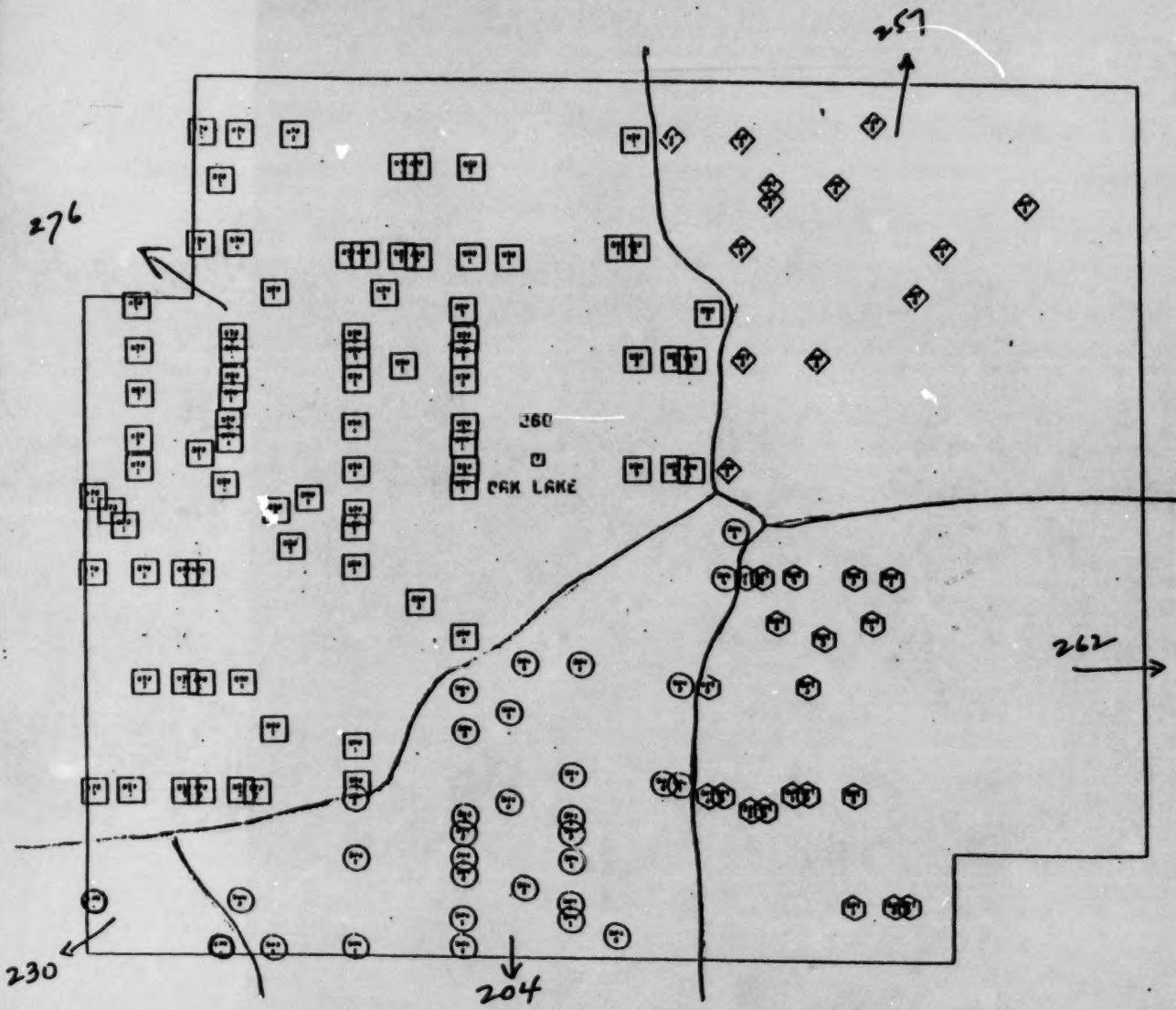
Appendix 4

RESIDENCES OF NATIVE AMERICAN STUDENTS JUNE 1983

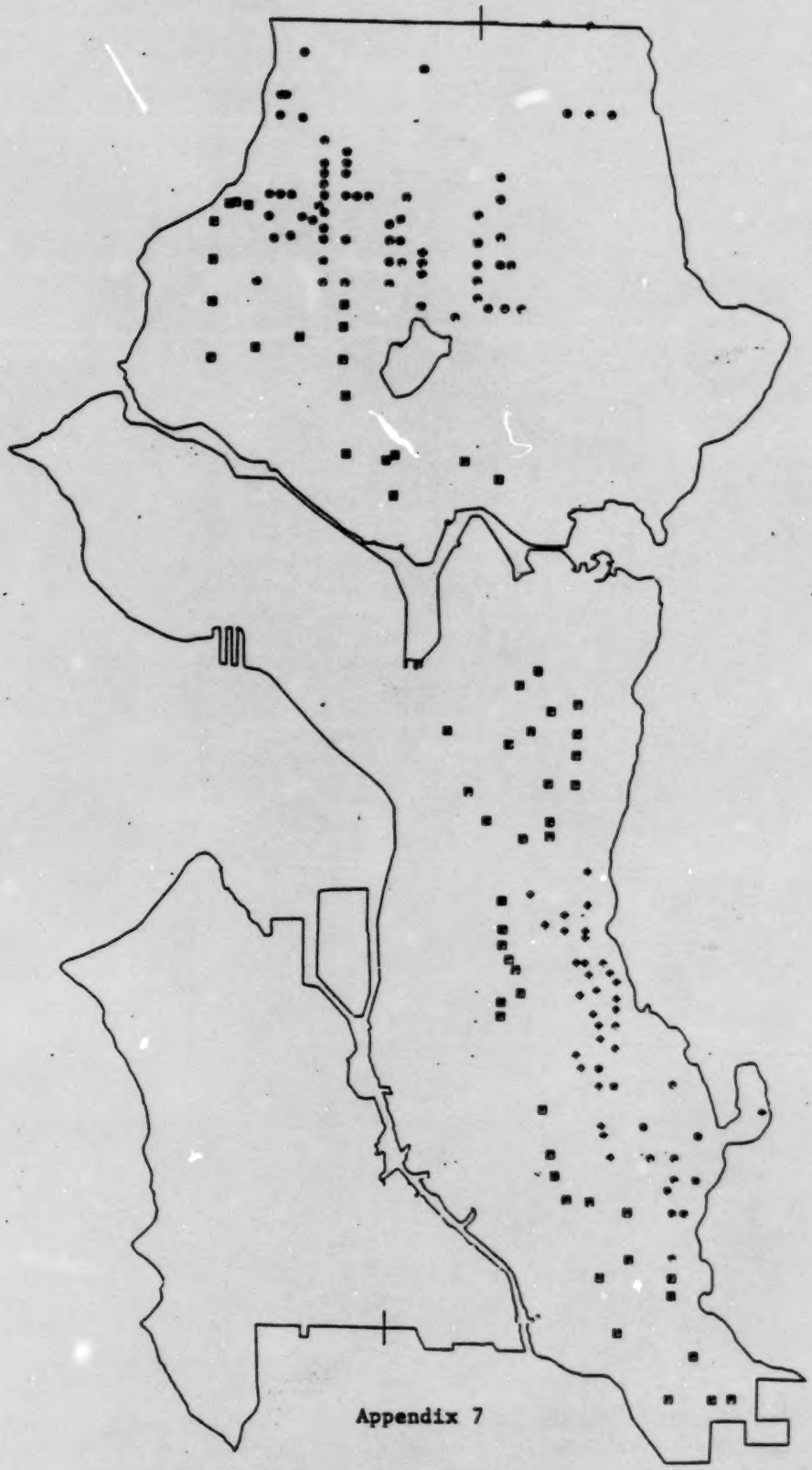

LEGEND
. = 1-5 STUDENTS
x = 6-20 STUDENTS
X = 21+ STUDENTS
This plot represents 21674 White students as follows:
9623 small X's = 18883 students
390 medium X's = 2765 students
1 large X = 26 students

Appendix 5

RESIDENCES OF WHITE STUDENTS IN SSD JUNE 1983

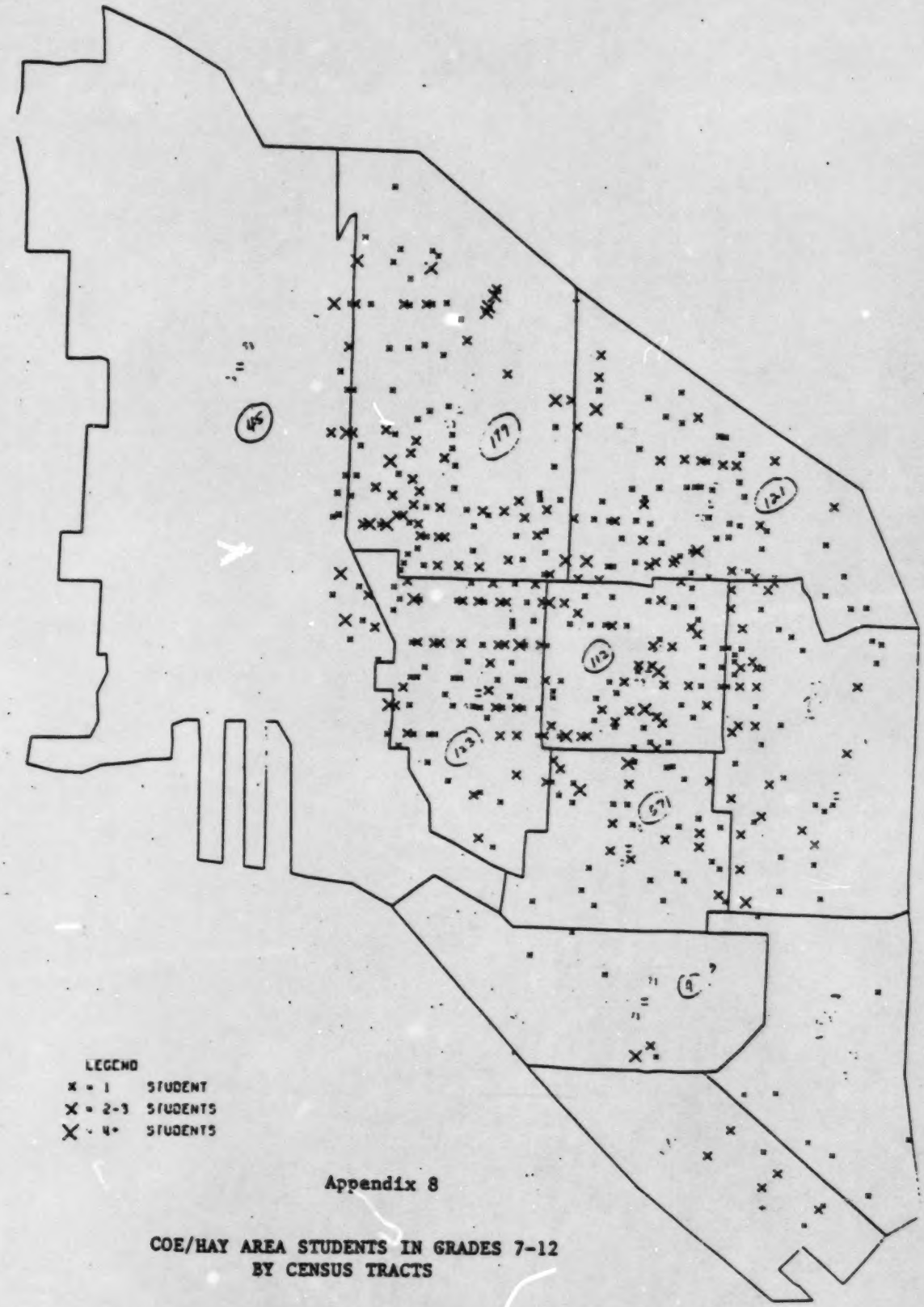


Simulation of Oak Lake Closure by Assigning K-6 Resident Students to Closest Elementary School



Appendix 7

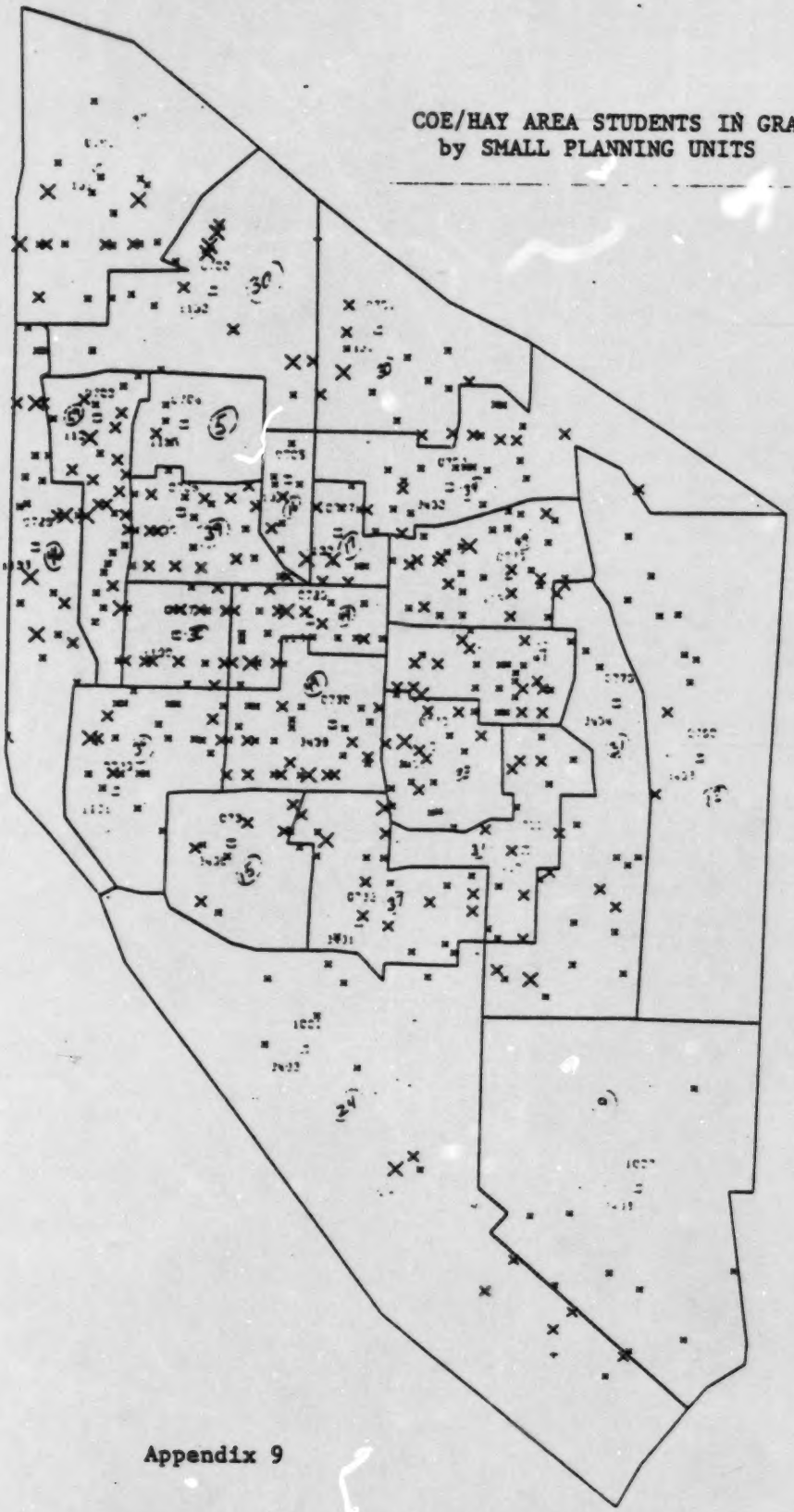
INGRAHAM HIGH SCHOOL BUS ROUTES/STOPS FOR 1983-84



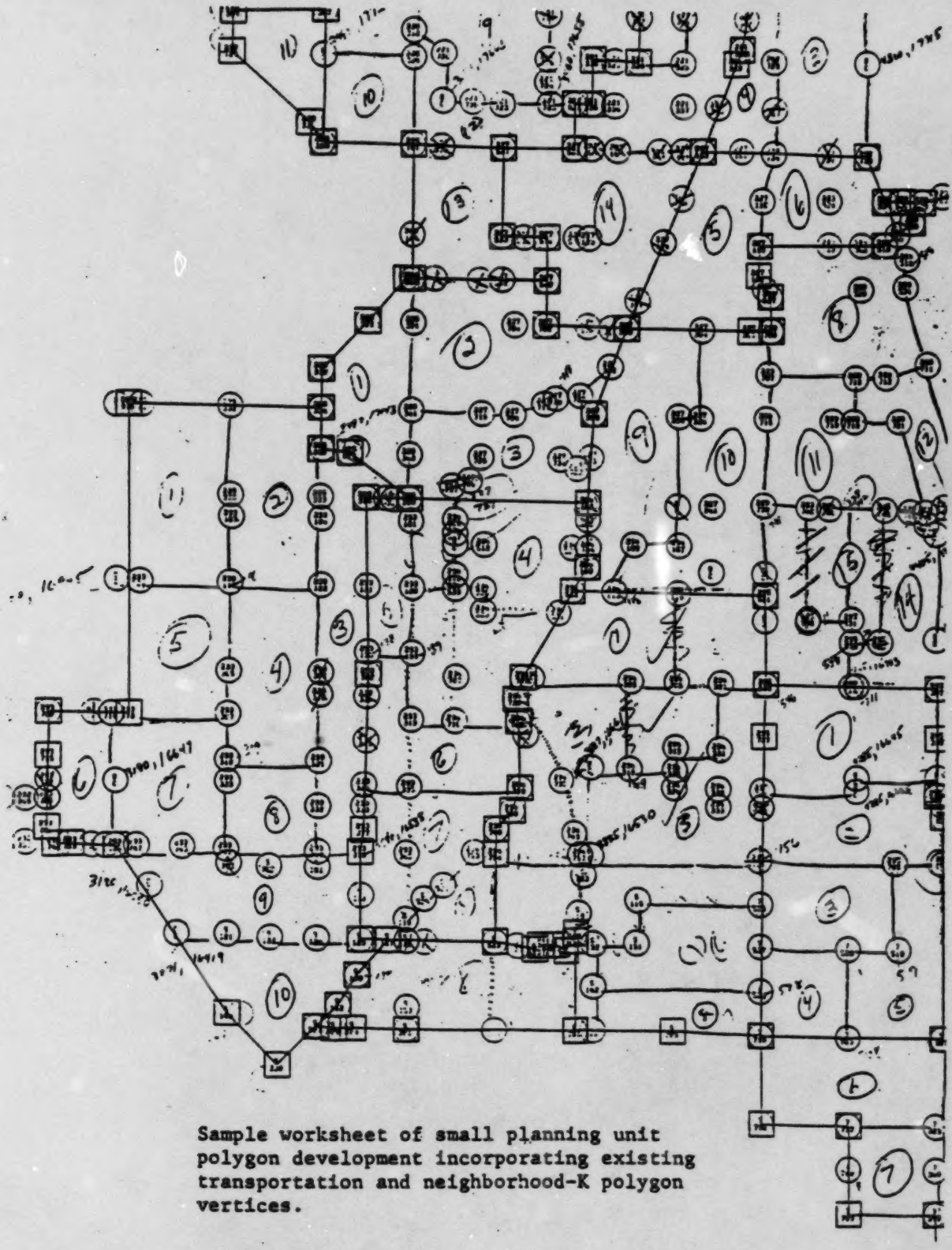
Appendix 8

COE/HAY AREA STUDENTS IN GRADES 7-12
BY CENSUS TRACTS

COE/HAY AREA STUDENTS IN GRADES 7-12
by SMALL PLANNING UNITS

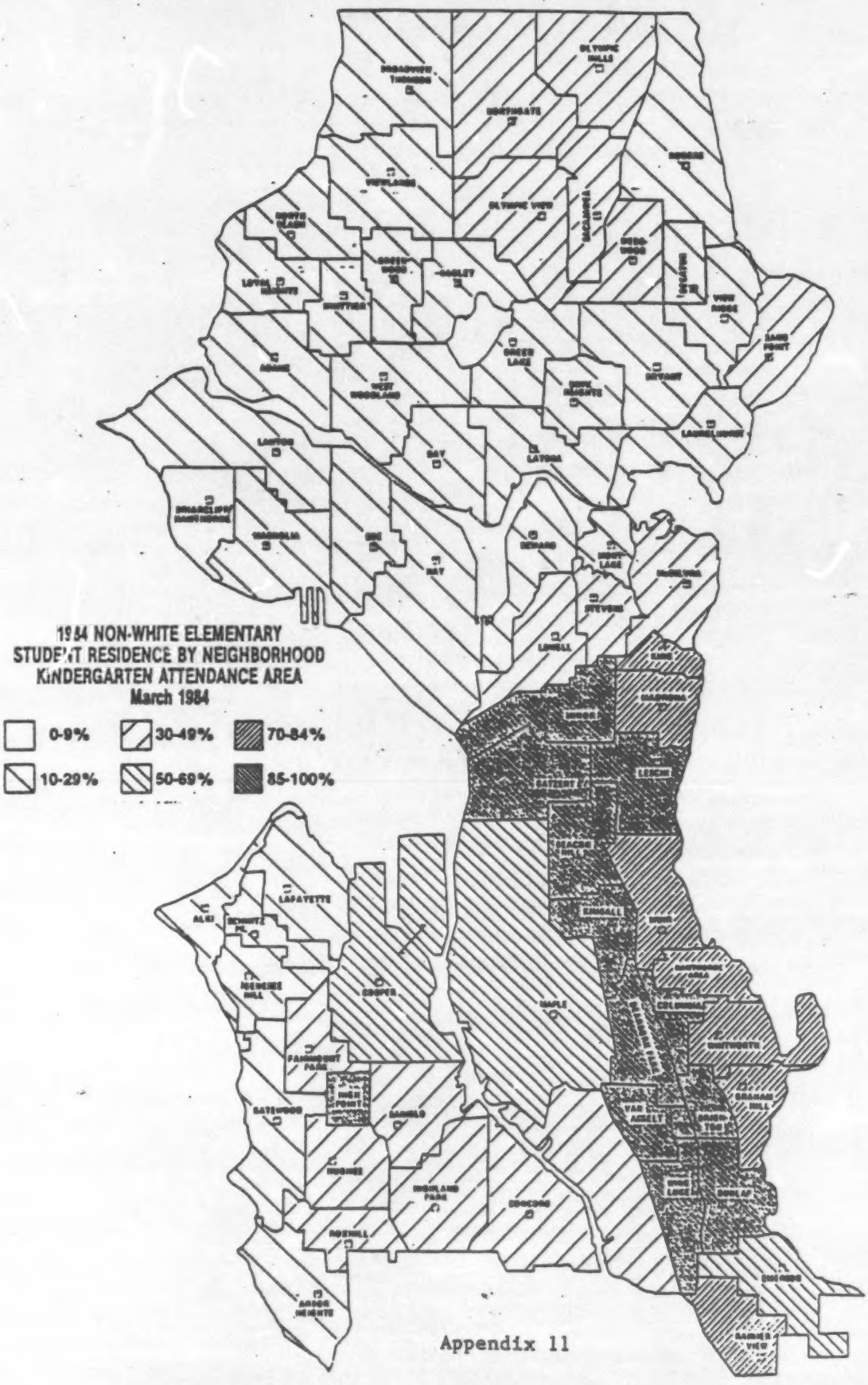


Appendix 9

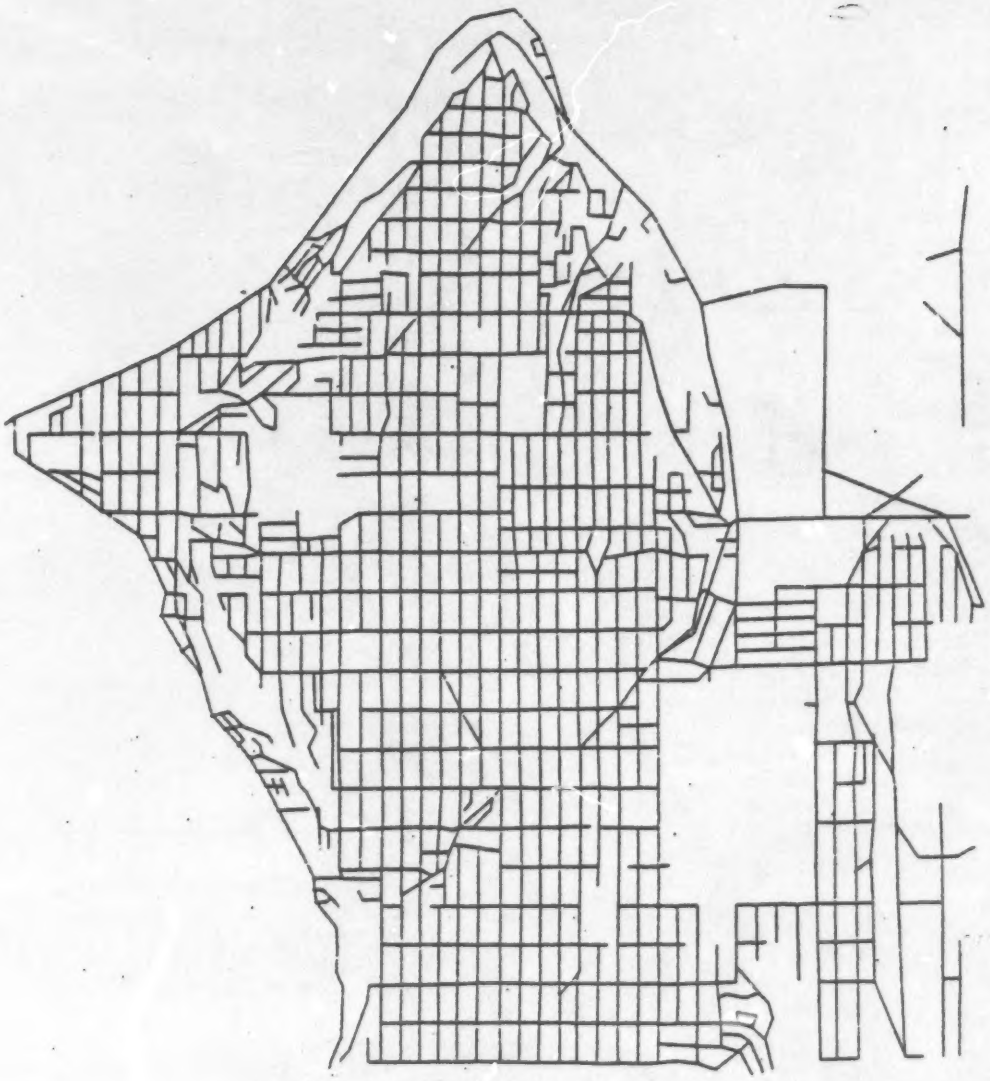


Sample worksheet of small planning unit polygon development incorporating existing transportation and neighborhood-K polygon vertices.

Appendix 10


1984 NON-WHITE ELEMENTARY
STUDENT RESIDENCE BY NEIGHBORHOOD
KINDERGARTEN ATTENDANCE AREA
March 1984
0-9%
10-29%
30-49%
50-69%
70-84%
85-100%

Appendix 11



NETWORK OF WEST SEATTLE AREA STREETS
(approximately 6 square miles)

Appendix 12